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WORLD PETROLEUM

Argentine Petroleum Law Retards Development—Regulations to Be Issued • Importers Burn Fingers in India • Cole Committee Preparing Report • Economy and Geology of Hobbs, N.M. • Increasing Production 20,000,000 bbl. with Acid Treatment • Antwerp—A Modern Oil Terminal

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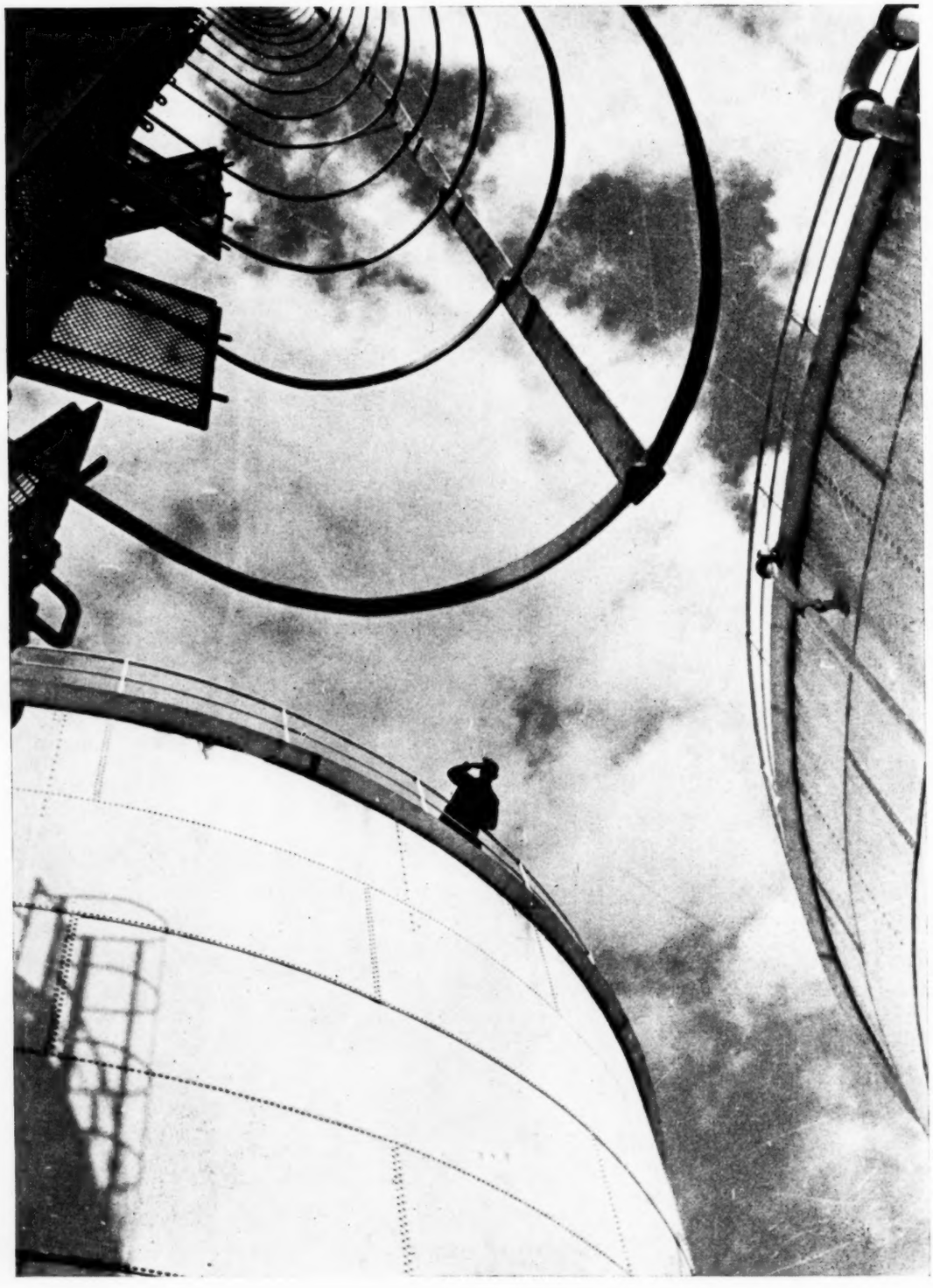

Storage tanks of the Rheuania-Ossag (Shell) at Hamburg, Germany

NEW YORK • WORLD • LONDON

PETROLEUM

Blue Eagle Not Missed

PREDICTIONS from Washington that chaotic conditions in the oil industry of the United States would follow the suspension of the petroleum code resulting from the decision of the Supreme Court holding the National Industrial Recovery Act unconstitutional have not yet been realized. Production has risen somewhat above the level set by the former Oil Administrator for the month of June, but has exceeded it by not more than 3.5 percent in any one week. Refinery runs have increased but stocks of motor fuel have declined though perhaps not to the extent that might be considered desirable. With few exceptions the prices of crude oil and gasoline have been maintained at the levels established under the code. Price wars have been no more numerous or vicious than they were under the former régime. Consumption of products is extremely high and is being well maintained.

It is not possible, however, to regard the situation with entire complacency. There has been a special effort to avoid market disturbance. When the rule of the NRA was abrogated a strong appeal was made to individual concerns to maintain the conditions that had been in effect as to prices, wages and conditions of labor. This appeal has been generally observed. State authorities have been particularly vigilant in holding production in leash in their particular areas, as witness the activity of the Texas Railroad Commission in recent weeks. In California where state control measures are lacking there has been a disturbing rise in daily output and a demoralized gasoline market in the Los Angeles area but heroic efforts have been exerted by members of the industry to prevent a general break and thus far it has been avoided.

▽

Formulating a New Code

THERE is obvious danger that if the maintenance of market stability is left entirely to the individual efforts and good will of those members of the industry who have a sense of public responsibility the demoralizing practices, which, though not completely eradicated, have been kept in check to a great extent during the past two years, will gradually reappear. In one of the most important markets in the country, for example, an oil company executive made the statement a fortnight ago that practically all the companies operating in that territory were granting "secret" concessions to certain customers. They all deplored it but felt helpless to change so long as their competitors continued the practice.

To meet conditions such as this the marketing committee of the former Planning and Coordination Committee has been laboring for many weeks to elaborate a new code for the industry, building upon the code of fair practice which was adopted with approval of the Federal Trade Commission prior to the NRA code of 1933 but incorporating in it certain features based on the experience of the past two years. There has been criticism of the committee in certain quarters because it has not thrown its preliminary deliberations open to all comers, but the impossibility of formulating a satisfactory document of this kind in town meeting has been demonstrated in the past. The Committee is composed of experienced men who are not likely to produce a one-sided document. If they do they will have their labor for their pains. Any code that may be drawn up must have the approval of the Federal Trade Commission on the one hand and on the other must command the support of the various branches of the oil industry if it is to have even a fair measure of success, but to attempt its drafting in an open convention and with the assistance of the professional objectors who always make themselves prominent in such gatherings would condemn the whole attempt to futility.

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A Local Problem

NO CODE that disregards the rights of those members of the oil trade who are willing to conduct their business with legitimate consideration for the common welfare can be imposed upon the industry. The only chance of success before the committee framing the proposed new code is to produce something that will appeal as sound and reasonable to the honest and fair-minded members of the trade who constitute its great majority. If this can be accomplished such a code or statement of fair practices can be used as a guide or basis for discussion and agreement among the local groups and organizations that must deal with questions arising under it.

In final analysis the problems of competition, of maintaining reasonable prices and suppressing unfair practices, are mainly local problems, just as the maintenance of law and order in any community is a local problem. The ordinary man is more concerned about the good opinion of his neighbors than he is about some distant and impersonal governing power. The members

of an industry in a particular locality usually have a very accurate knowledge as to who constitute the law abiding and cooperative element in their own calling and who are the malefactors. To construct an enforceable code it is desirable, therefore, not only to embody in it right principles and reasonable regulations but also to provide means for enlisting the support and active cooperation of local interests, both independents and representatives of major companies.

This is not the method of bureaucracy but it is the basis of democracy. Price wars are almost invariably local in their inception. Next to eliminating them entirely the most important thing is to prevent their spread. Too often their destructive effects have been multiplied through the hasty action of some official far from the scene of conflict who issues orders based on a partial or incorrect view of the situation. It would seem the part of wisdom to let the local fire fighters first attack the blaze; if they cannot quench it other measures may be adopted and the higher authorities called into action.

▼

World Congress

IT IS A matter of regret, particularly to those who are primarily concerned with the technical phases of the oil industry, that the American Petroleum Institute should have found it impracticable to accept the suggestion that the next World Petroleum Congress be held in the United States in 1936. The decision was not lightly made, however. The matter was carefully canvassed by a special committee appointed for the purpose and its members based their decision upon highly practical considerations.

So many important meetings are held in this country every year by national, sectional and local organizations, scientific societies and groups of operating specialists that it imposes a considerable burden upon the busy technical man to keep up with all these activities or to participate in even a small proportion of them. The World Congress is too important to be treated as a side issue to any of these other gatherings and to find a suitable time for it without conflicting with other established events is extremely difficult. Moreover, much time and careful planning is required to produce a comprehensive and well balanced Congress program and it was felt that there was no organization available to handle these preparations in time for a meeting to be held next year. It was looked upon as preferable to sacrifice the opportunity of claiming the next meeting for the United States rather than undergo the risk of failure to equal the high standard set by the last previous Congress.

There has been some discussion as to holding the next international assemblage in the Soviet Union. A meeting in Moscow would be full of interest, especially if supplemented by excursions to some of the important sections of the Russian producing and refining areas. An obstacle to attendance at a Moscow meeting is the distance which many of the visitors would be compelled to travel and the political opposition which might arise in certain countries against the sending of an official delegation to the U.S.S.R.

Many reasons point to London as being, above all others, the logical place for holding recurring sessions of the World Petroleum Congress. First of all there is the remarkable success of the 1933 meeting under the able management of committees appointed by the International Petroleum Technologists. In London the Congress has a worthy setting and does not have to share attention with many other meetings devoted to the same class of subjects as in the United States. London too is a world centre toward which well established travel routes converge from all parts of the globe. We venture to say that if announcement were to be made that the next world technical gathering was to be held in London it would be hailed with satisfaction and indeed with enthusiasm in all quarters of the international petroleum industry.

▼

Politics and Business

EVIDENCE of the vitality behind the movement toward business recovery in the United States is shown by the fact that the forward tendency has been merely checked and not completely reversed by the action of the Roosevelt Administration in proposing measures that must be adjudged on the most favorable interpretation as punitive rather than constructive and in insisting upon their adoption before the adjournment of Congress. The change in attitude that has taken place since the Supreme Court delivered its decision late in May against the constitutionality of the National Industrial Recovery Act suggests that the political strategists of the White House must have concluded that the attainment of their ultimate aims as well as the forwarding of their immediate political fortunes will be assisted by the obstruction of business progress rather than by its encouragement.

It seems difficult to credit the deliberate adoption of such a course by the responsible head of the government but it is difficult to account on any other theory for the sudden thrusting upon Congress of an entirely new scheme of taxation which apparently will be far more effective in dissipating large fortunes and in penalizing large enterprises than in producing revenue. Accompanying this move has been the renewed demand for turning over to a politically appointed body control of the credit resources of the country, insistence upon the application of the "death sentence" to holding companies and demand for nationalization of the coal industry—a foretaste of what may be in store for oil and other natural resource industries.

Viewed solely from the political angle it is not difficult to see that while the interests of the Administration, prior to May 27, were bound up with progress toward industrial recovery it may be held that since that date the position has been reversed. The attempt to introduce a radical change into the constitution of the government is likely to flourish much more under continued disorganization and discontent than alongside a sustained march toward business activity and renewed prosperity.

So far as the oil industry is concerned the events of the past two months in Washington undoubtedly have strengthened tremendously the opposition to federal regulation so that even the most outspoken advocates of national control have moderated their support. It is admitted that nothing but a direct demand from the President will now force Congressional action establishing federal control of the oil industry, and such action might entail a political price that the Administration would hesitate to pay.

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Argentina's Oil Law Retards Development

Because of Provisions in Existing Legislation Which Virtually Bar Outside Companies from Production the Nation Continues to Import Fifty Percent of Requirements.

WHILE every sovereign power has the unquestioned right to manage its own affairs as it sees fit it would appear to an outside observer that the government of Argentina is standing in its own light and preventing the effective development of its unquestionably great oil reserves by the policy it has pursued in reference to the petroleum industry. This policy undoubtedly has been influenced by the great wave of nationalistic sentiment which has swept over a large part of the world in the past few years and has led many nations to attempt to develop industrial programs that have proved expensive to administer and have failed to produce the results anticipated.

For the past few years development work in Argentina has been restricted to a minimum by withdrawal of the most promising areas from exploration and by uncertainty regarding the future resulting from the political controversy over the policy to be adopted. Socialists, in and out of Congress, have fought for the nationalization of the oil industry through establishment of a government monopoly. Other groups, while unwilling to go this length, have demanded a law that would restrict the exploitation of production to domestic interests represented by the Yacimientos Petroliferos Fiscales, owned wholly by the Federal government, familiarly known as the YPF, and that would enable the government to exercise actual control of all operations without the responsibility of direct ownership.

After some two years of debate and unsuccessful attempts at legisiation this issue was settled, for the time being at least, in favor of the latter group, by enactment of the petroleum law passed on March 21, 1935.

The principal provisions of this law may be summarized as follows:

Ownership of all oil deposits vests in the nation or the provinces according to their location. Surface ownership by a private individual gives no right to the subsoil.

Either the national government or state governments may exploit such deposits either directly or through mixed companies. National operations are to be conducted through the YPF but the states are at liberty to select their own agencies.

Power to limit or prevent importation or exportation of oil is lodged in the hands of the President.

Permits for exploration and development may be granted to individuals or companies but all such persons must be bona fide residents of the country and all corporations must have Argentine charters.

Permits for exploration may cover a maximum of 2000 hectare within five kilometers of a proved field but may be of 6000 elsewhere. This limitation applies only to exploration permits. No one person may hold more than ten permits in any one province. From these exploration permits, upon discovery of oil, the permitee may receive up to 1000 hectare of perpetual lease subject to 12 percent royalty and a surface tax of 10.90 M/N per hectare.

Pipe lines must serve as common carriers to the extent of their capacity in excess of the requirements of their owners.

Mixed companies are defined as those representing private capital and the government. Stock may be subscribed by both but in any case the president of the company and one-third of the directors must represent the government. Any of the government representatives can veto any resolution of the board or act of the manager—"contrary to law or the superior convenience of the state"—subject only to an appeal to the executive power (i.e. the President).

The government may withdraw any of the national lands from entry.

By the terms of this law, and of the presidential decree of May 14, 1935 withdrawing all national lands from entry for 10 years, which, in effect, gives complete control of all operations to the government, private companies are practically barred from the development of new lands. A certain amount of exploration and drilling is carried on by the YPF in the reserves but this is not sufficient to keep up with the growth in demand. As a consequence Argentina imports about 50 percent of her petroleum requirements, although the country, under a more progressive program of development, undoubtedly could satisfy its own needs.

While the oil companies that have built refineries in Argentina did so with the expectation of drawing supplies from the admittedly large reserves within the country, in great part, they have been unable to do this and have been compelled to import crude for the operation of their plants. Even these imports have been attended with difficulty because of exchange conditions. Official exchange, which is some 50 points below free market exchange, has been obtainable only from a government committee. Unless it can be shown that it is counterbalanced by an equal amount of Argentine exports an extra premium of 20 percent is charged.

Under the policy supported by the government motor fuel sells at a uniform price throughout Argentina. One pays the same price at a station located in a high pass of the Andes as in the heart of Buenos Aires. This price recently has been 22 centavos per liter which equals approximately the same number of cents per gallon in U. S. currency. The policy is an excellent one from the viewpoint of the consumer in the back country but it naturally entails a substantial loss to the oil companies on some parts of their distribution and is in effect a tax on the more favorably located markets such as Buenos Aires. In many of the municipalities licenses are granted to stations on condition that ownership of the equipment shall revert to the city after ten years.

Aside from the discouragement of normal development in production the effect of the recently adopted law is to confer still further advantages on the government affiliated company, the YPF, and to make more difficult the operations of independent companies.

Importers Burn Fingers In India Fight

Burmah Company Maintains Predominant Position for Indigenous Product Despite Competition of Low Priced Imports—Operations of Native Companies.

FROM the viewpoint of the oil industry, the glamour of British India departed many years ago. Keen competition, with some bitterly fought price wars, has kept the market on a strictly business footing for many decades, and we have it on the authority of Sir John Cargill, chairman of the Burmah Oil Company, that some of the participants in the latest struggle for business have "burnt their fingers" badly.

Speaking at the annual meeting on the company's distributing operations, the Burmah chairman said that stern measures had been taken by the management against imports of distress oil from other countries, and that these steps had secured their objective. The volume of the Burmah Company's operations had been maintained, but only at some cost to itself in a lower level of earnings than would otherwise have been attained.

Sir John Cargill then added:

> The imports in question have been of oil notoriously unprofitable to those who produced it. And those who, tempted by its distress price, have imported it, have made nothing and will make nothing from their speculative purchases so long as the outlet they are seeking is an outlet which the indigenous production must have.
>
> It is no satisfaction to us that these importers have seriously burned their fingers. Much less is it that much good Indian money has been cajoled from ignorant Indian investors into these ventures. It is a satisfaction to us, however, that much more valuable and much more widely spread interests of Indian and Burmese nationals involved in the maintenance of the volume of indigenous production have been and will continue to be preserved.

This is fighting talk but it exemplifies the policy which has been followed consistently by the Burmah interests against all comers who could not present a logical claim to consideration in the Indian market. Thus far it has been successful in maintaining the predominant position of the company in that important market.

Results of competition may be seen from the accompanying record of officially quoted prices at Calcutta, representing the value of 8 imperial gallons f.o.b. or f.o.r. in Rupees and Annas.

Quoted Prices at Calcutta

Brand	Jan. 1934		June 1934		Jan. 1935		June 1935	
	Rs.	ann.	Rs.	ann.	Rs.	ann.	Rs.	ann.
Snowflake..	9	1	9	1	9	1	8	12
Rising Sun.	6	9	4	10	4	10	4	12
Victoria....	5	8	4	2	4	2	4	10

"Rising Sun" brand, which is probably the most generally popular brand in the Indian market, fell from Rs. 6 9/16 to Rs. 4⅝ during 1934, a decline of approximately 33 percent, although a small recovery in the price has since taken place. This provides a measure of the intensity of the resistance shown by the Burmah Oil Company and its associates to sales of overseas oil products.

Price cutting on these lines, however, is no new thing in India, as the history of the market shows.

Burmah Oil Company was established in 1902 as a reconstruction of an undertaking formed in 1886. As early as 1895 the original Burmah concern was fighting Royal Dutch for the Indian kerosene market. The price war lasted for something like ten years and brought down the quotations for lower grade kerosene by Rs. 1. 3 annas per 8 gallons. An understanding between the combatants was reached in 1905, which, as far as Burmah oil was concerned, eliminated the prospect of unregulated imports from the Dutch East Indies (Netherland India), the only source of large oil supplies in relatively close proximity to the Indian market.

A lapse of about six years found the Royal Dutch and Burmah combining against expansion of imports into India by Standard Oil Company of New York, resulting in a fresh decline in inferior kerosene by Rs. 1. 4 annas per 8 gallon unit.

Another price war, which is still fresh in the public memory, is that which was initiated by the Royal Dutch-Shell in 1927, following the purchase of Russian oil by New York Standard for sale in the Indian market. As the Royal Dutch-Shell had previously had its properties in Russia confiscated by the Soviet authorities under the general nationalisation scheme, it complained that oil which rightfully belonged to the group was being sold by Standard in competition with its products in India. These purchases of Russian oil had enabled Standard to compete much more effectively in India than when its selling prices there were based on Gulf price, with the addition of freight from America instead of Batum. Whatever the real cause of the conflict, it brought about a maximum cut of Rs. 2. 8 annas per unit in Bombay quotations for kerosene. As in former cases, however, the differences were finally composed, and, as will be seen from the accompanying tables, the Socony-Vacuum subsidiary in India now concentrates largely on lubricating oil. Its prices follow the general trend of quotations fixed by the British-owned companies.

These undertakings form a very strong group, with Burmah as the centre, and the Burmah-Shell Oil Storage and Distributing Company of India, Limited, as the main distributing organisation. Connections between this concern and the Royal Dutch-Shell and Anglo-Persian are obvious. Assam Oil Company is brought into the Burmah-Shell organisation through Burmah's ownership of 98 percent of the Assam Oil capital. Attock Oil Company, although an independent undertaking, has an arrangement with the Burmah Oil Company for marketing its main products, and recently made arrangements for the latter to provide finance on debentures up to £200,000, if required, to enable Attock to prove the deeper oil horizons in the Khaur fields, in the Punjaub. British Burmah Petroleum Company, controlling the Rangoon Oil Company, also has a marketing agreement with Burmah.

Burmah, as a province, is, of course, predominant in Indian oil production, but the connections outlined above show that Attock, in the Punjaub, and Assam, the only other effective producing areas, have a close distributing association with Burmah Oil Company, which thus links the extensive producing and refining facilities of the British companies with the consuming public.

These companies contribute to a kerosene pool, which aims at a regular division of the market, and a stabilisation of

prices. A Government inquiry into the question of protecting the Indian oil industry, which reported in 1928, had little or nothing critical to say on the operations of this combination of resources.

There is one British oil company operating in India, the Indo-Burmah Petroleum Company, which is independent of the Burmah Oil Company's marketing arrangements, but, of necessity, its selling prices are largely determined by the policy pursued by the predominant distributing group.

Compared with the British companies operating in India, the Indian companies, some of which have sustained losses referred to at the commencement of this article in their effort to extend imports of foreign products, are financially small undertakings. It has been estimated that the total capital involved in them is in the neighborhood of 50 lakhs of rupees, equivalent to about $1,875,000 in American currency. They are purely Indian concerns, established and financed by natives. Their position is anomalous in that, while nationalistic sentiment has doubtless contributed to the local financial support they have received, they have turned to foreign sources for supplies of oil products. On the other hand, the British owned undertakings with which they compete, although financed from outside India, are employing a very large amount of Indian labor, and benefiting the country economically, by their producing and refining operations. Native owned production in India is negligible.

It is estimated that native Indian concerns have within recent years taken as much as 10 percent of the total oil business in the Indian market, and have endeavored to extend beyond this proportion. The accompanying list shows the five most important native companies.

Native Indian Oil Companies

Name	Principal installations	Products handled
Bombay Petroleum	Wadala	Kerosene Fuel oil
General Indian Petroleum	Calcutta,	Kerosene Fuel oil
Mills Stores	Karachi	Kerosene, Motor spirit Fuel oil
National Petroleum	Calcutta, Bombay	Kerosene Fuel oil
Western Indian Oil	Bombay, Madras, etc.	Russian, Motor spirit

Undertakings of this type conduct a regular importing business, for the most part buying f.o.b. the foreign port, and chartering tankers, the sharing of cargoes being a common practice between different companies. Practically no refining is done in India, finished products being bought, and after handling at the port installation, the purchases are sent, usually by rail, to up-country agents for distribution. Tins and drums are used very largely for transport purposes, as well as rail tank wagons. The character of the operations conducted, with the absence of treatment of products after import, explains why the native Indian companies can undertake a considerable business on a relatively small capital. Turnover is relatively rapid and there is no locking up of funds in wells or in producing and refining equipment.

Placed in this advantageous position, the native concerns have naturally been tempted by the low world level of oil prices, and particularly by the offer of distress oil in Roumania and elsewhere, to try to extend their operations during the past two years. That some of them have ended by "burning their fingers" in the process has been due to the very strong opposition they have met with from the Burmah Oil Company and its allies.

In putting up this opposition, the Burmah Company has been faithful to the policy which it has followed consistently since its earliest days. That policy has aimed at retaining the Indian market for indigenous production, and has been pursued with something bordering on statesmanship to the extent that a strong defence has sometimes led to an accommodation arrangement with rivals where this is advantageous.

No one would pretend to deny that, in the first place, the Burmah Oil Company, as a business undertaking, has acted in its own interests. Nevertheless, its policy has had many advantages for the Indian native community. If Burmah Oil has reaped good profits, India has had the advantage of consistent supplies and a relatively stable price, apart from the great gain resulting from a constantly developing internal oil industry, with its big absorption of local labor. A great part of these benefits would have been lost if a less vigorous defence had been made.

From the wider aspect of planned development, the Burmah Company's policy has also been beneficial, since it has resulted in India drawing oil very largely from Burmah and Netherland India, the areas which geographically are the natural sources of supply.

Oil Supplies for India Market*

(Barrels)

Kerosene

	Year to Mar. 31 1933	Year to Mar. 31 1934	Year to Mar. 31 1935
Russia	1,170,000	1,092,000	1,239,000
Persia	189,000	8,000	193,000
U. S. A.	105,000	65,000	23,000
Roumania	179,000	285,000	80,000
Netherland India	20,000	169,000	405,000
Others	37,000	42,000	21,000
Total imports	1,700,000	1,661,000	1,961,000
From Burmah	3,600,000	3,400,000	3,500,000
	5,300,000	5,061,000	5,461,000

Lubricating Oil

	Year to Mar. 31 1933	Year to Mar. 31 1934	Year to Mar. 31 1935
U. S. A.	326,000	394,000	375,000
Others	167,000	125,000	174,000
Total imports	493,000	519,000	549,000
From Burmah	200,000	200,000	200,000
	693,000	719,000	749,000

Motor Spirit, Benzine, etc.

All imports	146,000	46,000	41,000
From Burmah	1,200,000	1,300,000	1,500,000
	1,346,000	1,346,000	1,541,000

Fuel Oil Imports into India

(Barrels)

	Year to Mar. 31 1933	Year to Mar. 31 1934	Year to Mar. 31 1935
Persia	1,876,000	1,781,000	2,319,000
Roumania	146,000	244,000	33,000
Netherland India	740,000	843,000	714,000
Others	224,000	100,000	48,000
Total imports	2,986,000	2,968,000	3,114,000

*Assam and Attock production excluded.

Cole Committee Prepares to Report

Sub-organization of House Interstate Commerce Committee Expected to Recommend Approval of Interstate Compact, Limitation of Imports and Advisory Federal Allocations of Production

By Don J. Kirkley

WASHINGTON, JULY 30

A FINAL report to Congress from the Cole Committee recommending mildly turned legislative treatment for oil appeared a likely prospect on Capitol Hill as August opens with the industry restive and uncertain of what may happen.

While it still is not a verity as this is written, the probability is that a final report will be made to the House shortly by the special sub-committee of the Interstate Commerce Committee which has been studying the oil situation for a year past under the chairmanship of Representative William P. Cole, Jr., Maryland Democrat.

The report, it is said with considerable authority, will provide, in substance, for the following three points:

1. Ratification of an interstate compact.
2. Very limited federal authority to make advisory allocations of production necessary to meet demand.
3. Some flexible provision to limit imports in proportion to domestic curtailment.

There was a possibility that the committee might recommend authorization of voluntary agreements within the trade so as to permit refinery and marketing regulation, and perhaps propose the establishment of an advisory council of members of the industry to work with the federal and state governments.

One certainty appeared in prospect: a stipulation that any Board set up to act as a fact-finding and statistical unit in gathering figures for and making the advisory allocations should be an independent unit and not part of the Department of the Interior.

All indications point toward a disposition on the part of the committee to propose that these three steps, and no more, be taken at this session, leaving no course open for handling production regulation in states that have no state laws or agencies.

The attitude, expressed informally and privately by two of the members, is that the better policy would be to wait until the next session to go into that aspect of the matter, with the ensuing months to provide an opportunity to see what would happen.

Uncertainty in the industry over whether crude production will continue to be restricted, coupled with reports of price cutting in various parts of the country, combined to present an unsettled outlook as July closed.

Crude prices have been cut in two small Texas fields and Pennsylvania grade has been lowered 60 cents a barrel, these are developments since the Code and more or less compulsory regulation of production went out the window with the Supreme Court's decision abolishing the NRA.

Withdrawals from storage in the first eight weeks after the expiration of the Code aggregated 7,800,000 bbl. as compared with 21,000,000 bbl. during the entire code period of 21 months, in which withdrawals were not permitted except with approval of the Oil Administrator.

General uncertainty and apprehension was credited in oil circles here with the loss in oil stock values of some $700,000,000 in the period May 25–July 20. Total value of the 55 active stocks declined from $6,400,000,000 as of May 25 closing prices, to $5,700,000,000 at the closing quotations July 20.

To keep busy while awaiting the outcome of the legislative struggle the Petroleum Administration is enforcing the Connally law prohibiting interstate shipment of excess oil, and has embarked upon a nation-wide survey of what is happening in the absence of a Code.

Until the legislative outcome is determined, Administrator Harold L. Ickes is biding his time, unable to lay plans without some definite outline of Congressional authority upon which to act.

Efforts of Representative Wesley E. Disney (D-Okla.) to work out a compromise on which all the factions could agree, have been balked thus far by opposition from the Texas group of Representatives, in spite of a trip by Disney to the White House, where the President told him to count on his support if he could work out some sort of a trade with opponents of the legislation.

Disney's inability to get an agreement, plus his desire to work with the Cole Committee, which has spent about a year inquiring into the industry, has kept the Oklahoman from submitting a draft of a bill to permit a compromise. In addition to these developments, the undercover information is that Chairman Rayburn of the House Interstate Commerce Committee has said that no legislation will get out of his committee unless a member of the committee sponsors it.

The impasse between the two schools of action has now become so hopeless that those who advocate an interstate compact as a method of staving off federal control are becoming alarmed at inaction toward ratification. Opponents of oil legislation are fearful that to propose ratification might put the fight onto the floor of the House, where federal regulation probably would carry.

Just what the Cole Committee will do, as has been above set forth, remains somewhat indefinite as the month ends. Trade observers say that they have been reliably informed that even if the group brings in a bill, it will not press for action, but more reliable intimations point to action such as previously outlined.

During most of July, the Committee tried to act on the issues, with Cole seeking to hold formal sessions for consideration of a report. Illness and absence of Representatives Kelly (D-Ill.) and Wolverton (R-N. J.) prevented two or three tentatively called meetings, so Cole and the others in the Capital discussed things informally.

The present plan is for the Committee's report, when ready, to have right-of-way in the Interstate Commerce Committee, so that swift action can be possible there and the proposals taken to the floor. It is said by well-informed sources that this plan is the answer to a suggestion, made indirectly, by the President, that the Committee ought to settle on something before Congress adjourns.

Meanwhile, the industry goes on its way, with the American Petroleum Insti-

(Continued on page 483)

Geology and Economic Significance of Hobbs, N. M., Field

Fifth of a Series of Articles Dealing with Geology Production, Reserves and Economy of the More Important Oil Fields in the United States.

By Basil B. Zavoico

LEA COUNTY in southeastern New Mexico is one of the relatively new oil producing districts in the United States; it first attracted the attention of the oil industry in 1925 when the Hendricks field in Winkler County, Texas, but 10 miles due south from Lea County's southern boundary, was developed. Subsequently the southeastern portion of Lea County, comprising an area of some 1,000,000 acres, was actively explored by the drill until today there are in this county seven important oil pools, of which Hobbs is the largest. To January 1, 1935, some 400 oil wells were completed in Lea County, producing to that date 63,971,823 bbl. of crude oil, of which total Hobbs field accounted for 53,445,814 bbl., or about 83.5 percent. In addition to crude oil, a vast reservoir of natural gas was indicated to exist by several scattered wells, though lack of market outlets was not conducive to its active development and of the larger cities only El Paso, Texas, Phoenix and Tucson, Arizona, are now being supplied with natural gas from the South Jal field in Lea County. With the discovery within the last 12 months of three potentially important fields, Cooper, Monument and South Eunice, Lea County is currently witnessing its most active development campaign which should result in major extensions of older pools and outlining of new pools within the next year or two. The productive territory, while broken by apparently narrow saddles, is now practically continuous from Texas border to the Hobbs field, a distance of some 54 miles, as is shown on the accompanying map. The indicated remaining recoverable reserves in Hobbs field, which can be estimated closely, are placed at about 121,000,000 bbl., while the balance of Lea County can be considered to hold approximately an additional 100,000,000 bbl. in already developed acreage, and probably very considerably more in the new fields and in the extensions of the older fields, more particularly in Monument, Eunice, South Eunice and Cooper, as well as in the fields yet to be discovered. Hobbs field was discovered by the Midwest Refining Company, now Stanolind Oil and Gas Company, as a result of geophysical surveys with magnetometers and subsequently with torsional balance. The recent discovery at Monument is credited to seismograph work by the Amerada Petroleum Corporation, while all other fields were opened on the strength of regional subsurface geological work.

The development of Hobbs field and of other fields in Lea County has been very conservative and orderly, with spacing of one well to 40 acres, while all operators at all times fully cooperated with state conservation officers and among themselves to introduce into this vast area most modern development and producing practices. Actual drilling in Hobbs field has been very gradual and to date only three dry holes have been completed on its edges, an excellent record for a 9,000-acre pool. While the Hobbs field is not unitized its operators created the Hobbs Proration Committee, the Hobbs Executive Committee and the Hobbs Engineering Committee, which supervise all proration and conservation rulings through the permanently maintained office of Proration Umpire in Hobbs. At first these committees and the umpire were limited in their powers to the Hobbs field, but subsequently all other fields in Lea County were included, thus setting up a precedent of an operator's cooperative organization, assisted by the state, covering not only one field, but all related productive territory. The results achieved by the operators in Lea County definitely indicate that the cooperative effort has been an unqualified success and that the interested companies, the state and the fee owners will benefit by higher recoveries and by long flowing life of the fields. An important feature of Lea County is the fact that a large proportion of the land is owned by the federal government which issues permits for development and by the state which leases its lands at public auctions; patented fee land in private ownership is leased as elsewhere in the Mid-Continent area, carrying ⅛-th royalty.

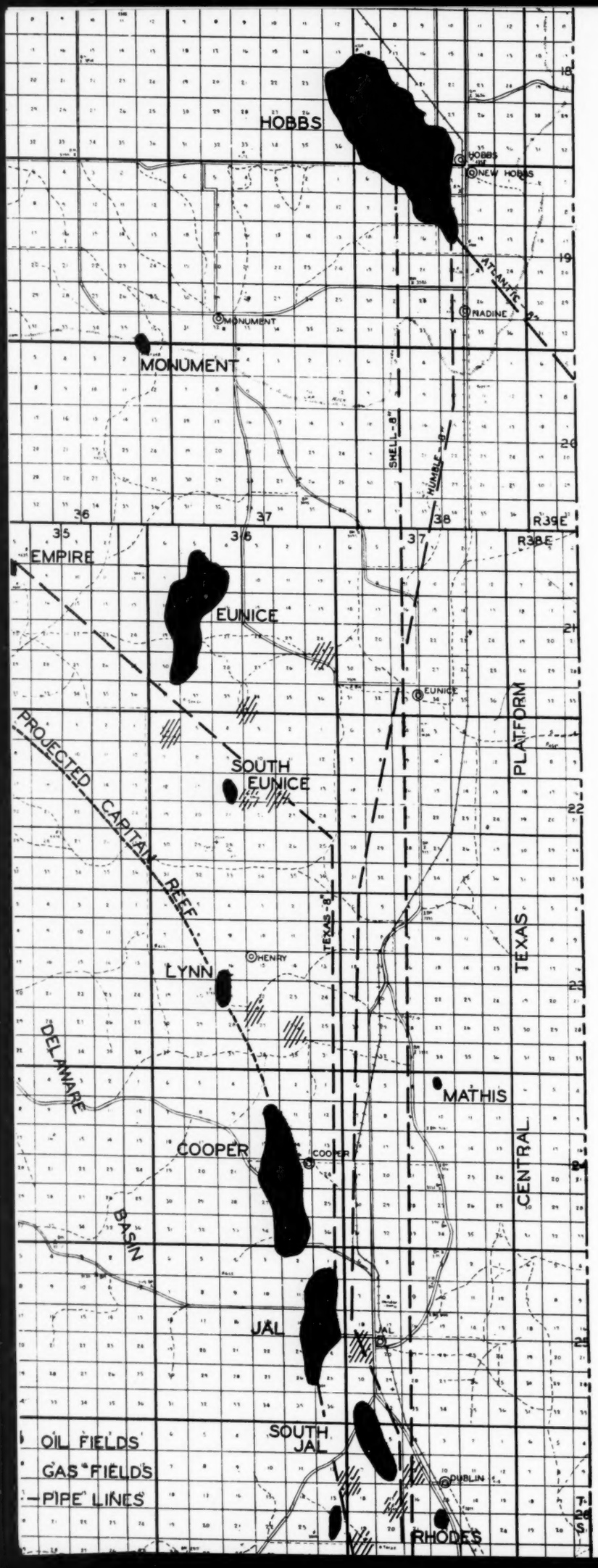
The scope of this article does not permit detailed discussion of all the fields in Lea County, and such detailed description will accordingly be limited to the Hobbs field, though various general features of other fields will be covered parallel with the Hobbs.

Development

THE DEVELOPMENT of southeastern Lea County can be divided into two separate periods: from 1927 to 1929 Jal, Hobbs, Lea and Eunice pools were discovered, of which, however, only Hobbs was actively developed reaching its maximum activity late in 1930; in 1934 and 1935 Cooper, Monument and South Eunice fields were discovered, and in the same period Jal and Eunice fields were greatly extended. At this writing Hobbs and Jal fields are fully developed, but the remaining four pools, Eunice, South Eunice, Cooper and Monument are currently being explored and during the balance of 1935 and in 1936 a very large number of wells will be drilled in these fields. The history of development of Lea County is briefly covered here in chronological order, with the discussion of producing formation, the dolomitic limestone of Permian age, postponed until the section dealing with the stratigraphy. It should be noted that all fields of Lea County have produced under strict proration and hence cumulative recoveries of fields developed in 1934 and 1935 are relatively small.

(1) South Jal field was discovered on November 1, 1927, by The Texas Production Company's No. 1 Rhodes in section 22-T.26 S.-R.37 E., which was completed for 300 bbl. of oil and 22,500,000 cu. ft. of gas per day initially from 3,212 ft., and which produced to January 1, 1935, 42,615 bbl.

(2) Hobbs field was discovered on November 8, 1928, by the Midwest Refining Company's No. 1 State in section 9-T.19 S.-R.38 E., which was brought in for 700 bbl. per day initially from a total depth of 4,220 ft. and which produced to May 1, 1935, 215,615 bbl. The active development of Hobbs field, however, dates to January of 1930 when Humble Oil and Refining Company (S.O.N.J.) completed its No. 1 Bowers in section 30-T.18 S.-R.38



General oil field development map of southeast portion of Lea County, New Mexico, showing oil fields, gas areas and pipelines

E., three miles due northwest from the discovery, for 9,720 bbl. per day initially from the total depth of 4,106 ft.; this well and its 40-acre unit twin No. 5 produced to May 1, 1935, 981,512 bbl. Cumulative production of Hobbs field to May 1, 1935, was 57,238,964 bbl. from 225 completed oil wells.

(3) Eunice field was discovered on March 21, 1929, by the Continental Oil Company's No. 1 M. Lockhart, a south edge well, in section 31-T.21 S.-R.36 E., which flowed initially 250 bbl. per day from a total depth of 3,990 ft. and which produced to January 1, 1935, 44,778 bbl. Cumulative production of Eunice pool to January 1, 1935, was 1,904,462 bbl. from 29 oil wells, of which, however, 19 were completed in 1934. In June, 1935, there were in Eunice field 56 oil producers and nine drilling wells.

(4) Small Lea field, 12 miles due west from Eunice field, was opened on May 5, 1929, by The Texas Production Company's No. 1 Lynch A. in section 34-T.20 S.-R.34 E., which came in for 1,100 bbl. per day initially from a total depth of 3,731 ft., and which, together with No. 2 and 3, produced to January 1, 1935, 1,297,832 bbl. Cumulative production of Lea pool to January 1, 1935, was 5,114,161 bbl. from 17 completed oil wells.

(5) Jal field was discovered on May 23, 1929, by the Skelly Oil Company's No. 1 Joyner in section 26-T.25 S.-R.36 E., which produced 438 bbl. per day initially from a total depth of 3,339 ft. and which accounted to January 1, 1935, for 165,393 bbl. Cumulative production of Jal pool to January 1, 1935, was 2,928,733 bbl. from 32 completed wells, these totals including the South Jal area. In June, 1935, there were in Jal and South Jal fields 43 oil producers and five drilling wells.

(6) Lynn field was discovered in 1930 by the General Crude Oil Company's No. 1-C State in section 16-T.23 S.-R.36 E., which came in for 140 bbl. per day initially from a total depth of 3,750 ft., after being plugged back from 3,953 ft. No. 1-C State produced to January 1, 1935, 27,545 bbl., while the cumulative production to that date of the whole Lynn field was 271,488 bbl. from four completions.

(7) Cooper field was actually discovered on April 20, 1934, by General Crude Oil Company's No. 1 Meyers in section 22-T.24 S.-R.36 E., which was brought in for 5,400 bbl. per day initially from a total depth of 3,509 ft. and which produced to January 1, 1935, 43,705 bbl. This discovery well, however, was originally completed as a 90,000,000-cu. ft. gas well from 3,438 ft. in July of 1929. Cumulative production of Cooper field to January 1, 1935, was 297,165 bbl. from 17 completed oil wells. In June, 1935, there were in Cooper field 48 oil producers and 13 drilling wells.

(8) Monument field was discovered in March 1935 by the Amerada Petroleum Corporation's No. 1-D State in section 1-T.20 S.-R.36 E., which produced initially 600 bbl. per day from 3,954 ft., and which after plugging back to 3,946 ft. and acidization with 2,000 gallons made 3,600 bbl. in 24 hours. Structurally Monument field appears to be a major development and may compare with Hobbs field in size and in recoveries. In June, 1935, there were in the Monument field two oil producers and six drilling wells.

(9) South Eunice field was discovered on

June 7, 1935, by the Ohio Oil Company's No. 3 McDonald-State in section 16-T.22 S.-R.36 E., which was brought in for 12,000 bbl. per day initially from a total depth of 3,816 ft.

Of the fields classified above South Jal, Jal, Cooper and Lynn will in all probability eventually develop into one continuous producing area some 23 miles in length and 1½ miles in width, covering some 22,100 acres, along the buried extension of the "Capitan Reef"; while Hobbs, Monument, Eunice and South Eunice will remain individual fields separated by saddles with their size as yet undetermined, excepting Hobbs which has been fully defined and covers some 8,900 acres, while the still undefined Eunice field already covers around 3,700 acres.

The well spacing of one to 40 acres (a proration unit) has been strictly adhered to in all fields of Lea County, inasmuch as allowable production is granted only on the basis of these 40-acre units regardless of the number of wells drilled on each, the only consideration given to several wells on a unit being in the Hobbs field where unit potential is calculated on the basis of the average potential of two or three wells drilled on the very few units prior to the spacing agreement.

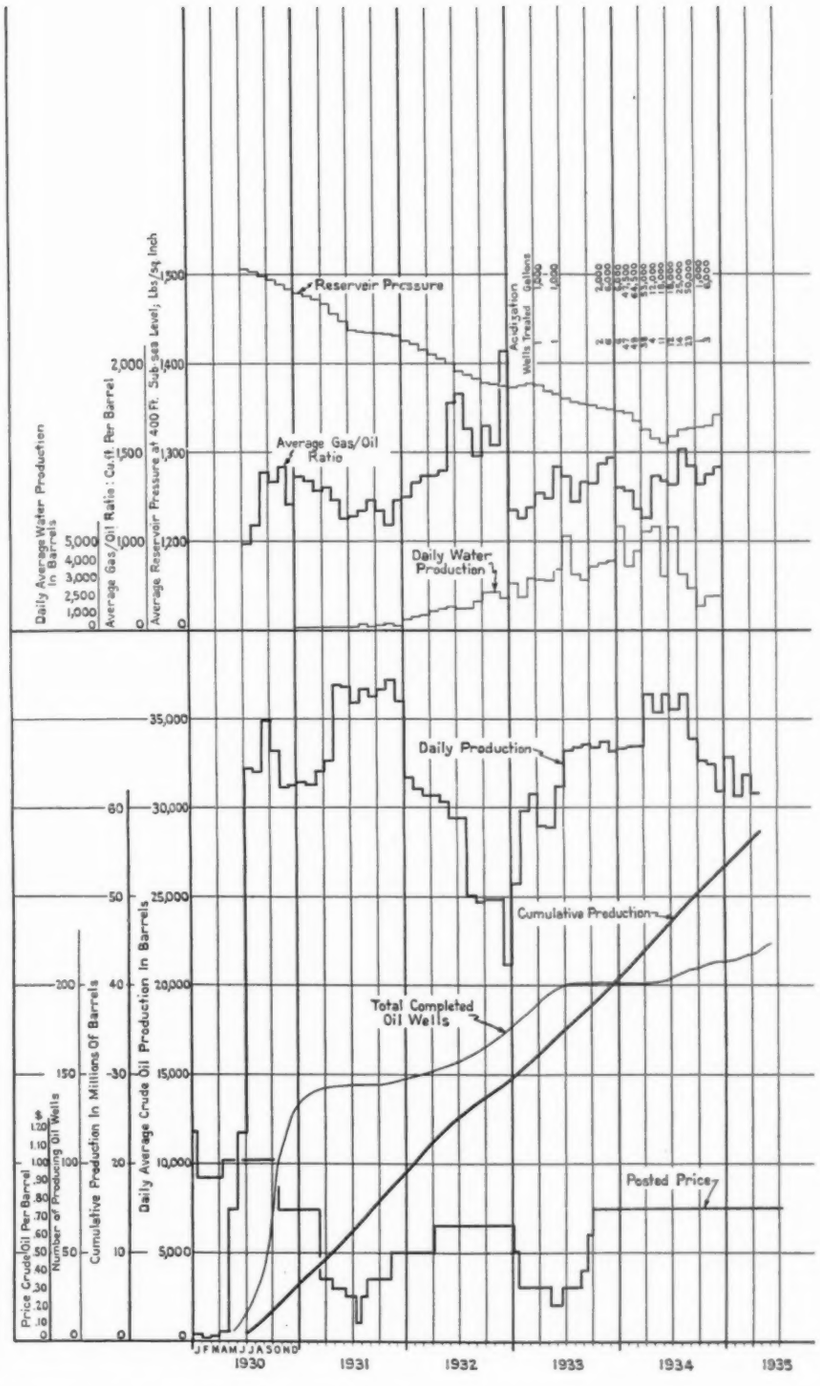
The statistical data of Hobbs field are presented in Table I, which shows production, development, recoveries and estimated reserves. Other fields in Lea County are as yet insufficiently developed to make reliable detailed summaries of their reserves, though tentatively it may be assumed that cumulative recoveries of secondary pools like Cooper, Jal or Eunice will not exceed 10,000 bbl. per acre.

Proration History

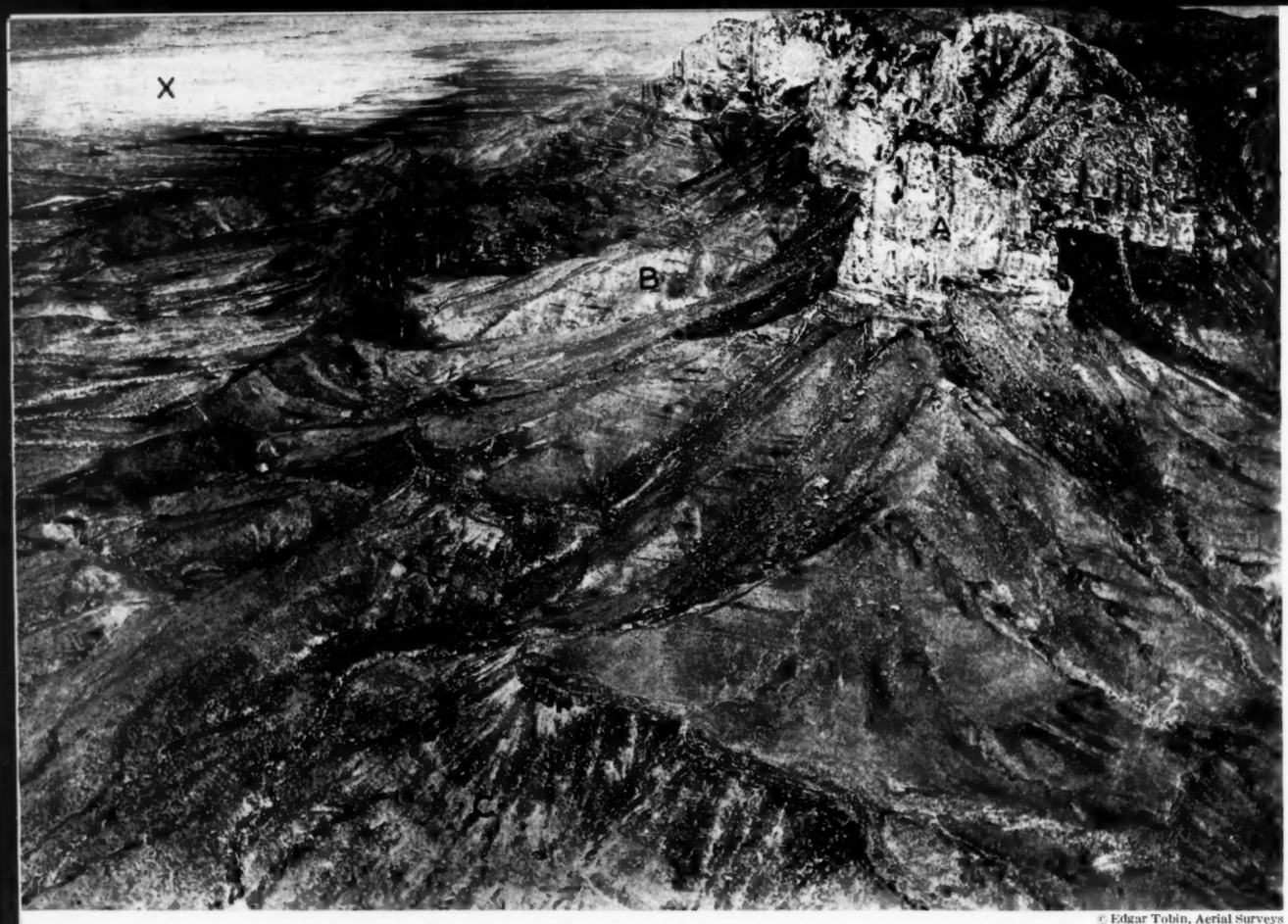
THE STATE of New Mexico very early realized the necessity of constructive oil legislation and in 1929 the state legislature enacted precedent-setting bills 97–601 and 97–602 permitting unit and cooperative agreements between operators and royalty owners and not considering such agreements as a violation of any statutes relating to monopolies or contracts and combinations in restraint of trade, provided such agreements have approval of the State Geologist; and also authorizing the Commissioner of Public Lands to enter into such agreements on behalf of the state where state lands are concerned and when in his judgment by such agreements the best interests of the state are served.

First proration agreement affected only the Hobbs field and it became effective on July 10, 1930, when it was approved by the State Geologist and by the Commissioner of Public Lands. The first agreement was subsequently amended in minor details. In general the final agreement provides:

(1) For setting up an organization to supervise and administer proration in Hobbs field, including: the Hobbs General Proration Committee composed of one representative from each operator in the field; the Hobbs Executive Committee composed of seven members elected from and by the General Committee with State Commissioner of Public Lands and State Geologist as ex officio members, this Committee being directly charged with the responsibility of arranging and supervising proration; the Hobbs Engineering Com-


Reservoir Pressure
Average Gas/Oil Ratio
Daily Water Production
Daily Production
Cumulative Production
Total Completed Oil Wells
Posted Price
Daily Average Water Production In Barrels
Average Gas/Oil Ratio: Cu.ft. Per Barrel
Average Reservoir Pressure at 400 Ft. Sub-sea Level; Lbs/Sq. Inch
Acidization Wells Treated Gallons
Price Crude Oil Per Barrel
Number of Producing Oil Wells
Cumulative Production In Millions Of Barrels
Daily Average Crude Oil Production In Barrels
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1930
1931
1932
1933
1934
1935

Progress development chart of Hobbs field, showing daily and cumulative crude oil production, water production, accumulated oil wells, reservoir pressure, gas/oil ratios, progress of acidization and posted prices



Looking N.N.W. along the Guadalupe Range, Culberson County, Texas, showing Guadalupe Point of Capitan limestone (A); Delaware Mountain sandstone section (B); Bone Springs limestone (C); and a dried up lake (X).

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mittee composed of engineers of all operating companies meeting once each month for discussion of engineering practices and of new field developments; and the office of permanently employed Proration Umpire to administer proration and keep all necessary records. C. G. Staley has been the proration umpire since the inception of that office. Subsequent changes extended the activity of the proration umpire and of the engineering committee to all of Lea County and the proration umpire was also appointed a Deputy State Commissioner in order to be able to enforce state regulations. The cost of running the umpire's office is distributed among the operators in the field, and currently it averages $0.001 per barrel.

(2) For division of Hobbs field into 40-acre units, with unit potential production based upon the average of potentials of several wells on a unit if more than one well was completed on each, and limiting all subsequent drilling to one well per each 40-acre unit, to be located at least 330 ft. from boundary lines.

(3) For calculating the allowable production on the basis of allowing 25 percent to the number of units and 75 percent to the potentials, excepting water producing wells in which case the allowance is 40 percent for acreage and 60 percent for potentials.

(4) For taking and calculating potentials. The first method of taking potentials provided for 3-hour open flow tests through 3-inch tubing with production for the last two hours multiplied by 12 to obtain 24-hour potential. This method proved unsatisfactory because the production of large wells was limited by the small size of tubing, and therefore in August, 1930, a substitute method was adopted allowing wells to flow open for 1½ hours through casing and tubing and calculating the potentials by multiplying production of the last 60 minutes by 24. Again in September, 1930, a new method was experimented with by allowing wells to flow open through tubing for 1½ hours and through tubing and casing for one hour, calculating the potentials by multiplying last hour's flow by 24, this method of testing still being used on some new wells. It was found, however, that by testing wells through casing and tubing a considerable amount of gas waste is entailed and during September, 1930, tests the relationship between tubing only and open flows was studied and plotted and subsequent well potential tests were based upon 2-hour flows through tubing alone, multiplying last hour's production by 24, and evaluating the open flow potentials from the resultant curve. Thus it was found that a 3,000-bbl. production through tubing corresponds to 3,900-bbl. open flow production through 3-inch tubing and 7-inch casing; a 4,000-bbl. production through tubing to a 5,700-bbl. open flow production; a 5,000-bbl. production through tubing to an 8,000-bbl. open flow production; a 6,000-bbl. production through tubing to a 12,600-bbl. open flow production; a 7,000-bbl. production through tubing to a 15,200-bbl. open flow production; and an 8,000-bbl. production through tubing to a 25,600-bbl. open flow production. Effective October of 1932 the agreement was extended providing for determination of new potentials of old wells on the basis of their former potentials and the quotient

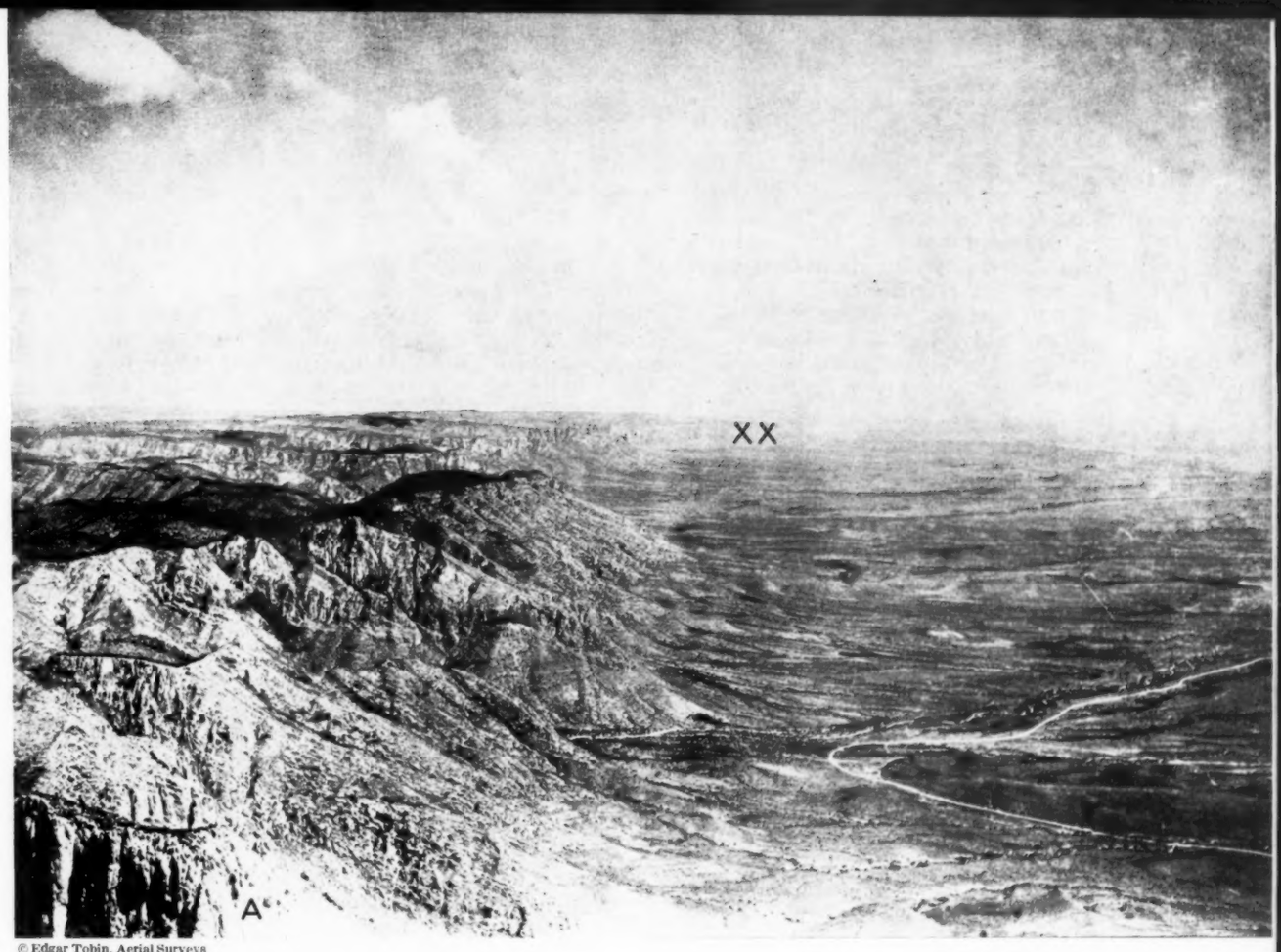
TABLE I

Production, Development, Recoveries and Estimated Reserves of Hobbs Field, New Mexico, May 1935

Actual producing area, acres	8,520
Probable extensions, acres	400
Estimated total productive area, acres	8,920
Number of completed oil wells	225
Average well spacing in producing area, acres per well	37.85
Probable number of oil wells to be completed	10
Average ultimate well spacing in productive area, acres per well	37.95
Current 24-hour potential production through casing and tubing, bbl.	2,279,595
Average daily production during April, 1935, bbl.	30,682
Total recovery to May 1, 1935, bbl.	57,238,964
Average recovery per well to May 1, 1935, bbl.	254,600
Average recovery per acre to May 1, 1935, bbl.	6,720

Estimate of Reserves

Estimated Ultimate Average Recovery per Acre, bbl.	20,000
Estimated Total Ultimate Recovery, bbl.	178,400,000
Estimated Ultimate Recovery per Well, bbl.	758,000
Remaining Recoverable Reserves, bbl.	121,161,036



Looking N.E. along the Guadalupe Range, Culberson County, Texas, showing Guadalupe Point of Capitan limestones (A); and the northeastward plunge of the Capitan limestone reef in the direction of Lea County, New Mexico, pools (XX). At the top right may be seen the Pecos River.

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between last and new reservoir (bottom-hole) pressures to be taken quarterly, thus eliminating entirely even tubing tests. Subsequently special provision was made for thorough testing of acidized wells, rules requiring three actual potential flow tests at 90 day intervals before applying reservoir pressure method of calculating new potentials.

The June, 1935, proration schedule is calculated on the basis of 225 producing oil wells located on 214 40-acre units, of which one with a 7-bbl. marginal well is eliminated from calculations, leaving 213 units. Of these 42 are classified as water units, having a combined potential of 184,290 bbl. per day, and these are using the 40/60 acreage/potential plan, giving each unit an acreage allowance of 59 bbl. and a potential factor of 0.0082941; while the remaining 171 units with a total potential of 2,102,144 bbl. per day use 25/75 acreage/potential plan, giving each a unit acreage allowable of 40 bbl. and a potential factor of 0.0098756. On this basis 214 units with 225 oil wells have a combined potential of 2,286,464 bbl. per day and are allowed to produce 31,614 bbl. per day, allowable production of individual wells running up to 280 bbl. per day. In the balance of Lea County with allowable granted on 40-acre unit acreage basis alone in June, 1935, each unit was allowed to produce 148 bbl. per day, there being in the county 135 non-marginal wells with an allowable of 19,954 bbl. per day, and 38 marginal wells with actual production of 2,178 bbl. per day.

The Hobbs field organization for handling proration, drilling and production practices represents an unqualified and remarkable success of cooperative effort and at no time were serious difficulties encountered. However, an attempt made by major operators in 1932 to unitize the field ended in failure even though a large majority favored the unitization.

Drilling Practice and Costs

WITH THE exception of the discovery well of the Hobbs field, which was drilled with cable tools, and a few subsequent wells which used combination rotary and cable tool rigs, the great majority of wells in Hobbs were and are drilled with rotary rigs. Contractors were employed to drill practically all wells, though Gypsy Oil Company (Gulf) and some others operated their own rigs. The drilling in Hobbs is fairly simple at this time though earlier in the history of the field some months elapsed before drillers learned how to handle large volumes of gas economically. State drilling regulations for protection of shallow fresh water sands and also of potash bearing salt beds require definite casing and cementing programs, and these increase somewhat the drilling time, more particularly if compared with drilling speeds in the Gulf Coastal fields. Rotary rigs are at this time used exclusively in all other fields of Lea County, as well as for wildcatting.

The equipment used in drilling includes standard steel derricks 122 ft. high and measuring 26 x 26 ft. at base; 66-inch and a few 76-inch travelling blocks; four and five-sheave roller bearing type crown blocks; 6-inch draw works driven by 12 x 12-inch twin cylinder steam engines; enclosed or open type 20-inch roller bearing rotary table; and 14½ x 7½ x 18-inch size slush pumps. A few wells in Hobbs field and elsewhere in Lea County were drilled with Diesel power. Blow-out preventors have been used in all wells. Drill pipe used is 6⅝-inch OD, 25.20 lbs., from surface to 2,750 ft.; 4½-inch OD, 14.60 lbs., from 2,750 to 3,950 ft.; and 3½-inch OD, 13.30 lbs., from 3,950 to the average total depth of 4,175 ft. Digging of mud pits in Hobbs field in hard caliche presented unusual difficulties and on some locations blasting was necessary, running the cost of pits up to $750 per location; caliche being so hard in Hobbs that in many cases cable tool spudders were used to drill through it to a depth of about 50 ft. before starting with rotaries. In Hobbs field the shallow fresh water horizon encountered at from 50 to 150 ft. provides a cheap water supply, but in some other areas of Lea County the water supply presents a major

and a very expensive problem. Natural gas is used exclusively as the fuel for boilers of which three of 90 to 125 HP are used for each drilling rig, with working pressures ranging from 250 to 350 lbs. The average time of drilling in and completing a producing oil well in Hobbs is around 30 to 40 days, though first wells required normally from 60 to 70 days.

TABLE 2

Analyses of Drilling Costs in Hobbs Field in 1934–35

Total footage drilled to June 1, 1935—940,000 ft.

To Lease Investment:			**$23,550**
Including	122-ft. derrick complete and erected	$ 1,536	
	Cellar and Pits	350	
	Extra material for derrick	450	
	225 ft., 13⅜-inch, 61 lbs., casing @ $2.00/Ft.	450	
	2,750 ft., 9⅝-inch, 40 lbs., casing @ $2.15/Ft.	5,912	
	4,000 ft., 7-inch, 24 lbs., casing @ $1.32/Ft.	5,280	
	4,200 ft., 3-inch, 9.3 lbs., tubing @ $0.56/Ft.	2,352	
	Freight and hauling	1,000	
	Fuel	200	
	Cement and cementing expense	1,100	
	Drilling mud	1,000	
	Well head connections	750	
	Miscellaneous labor and materials	1,000	
	2—500-bbl. tanks	1,070	
	1—oil and gas separator, 4 x 12½ ft.	600	
	Flow lines and connections	500	
To Drilling			**$18,600**
Including	Contract, 4,200 ft. @ $4.25 per foot	17,850	
	5 days' time @ $50	250	
	All other miscellaneous	500	

Contractor furnishes water; company provides fuel.

The casing program in Hobbs, prescribed by the office of the State Geologist, provides for 200 to 250 ft. of surface pipe, 12 or 15-inch, to protect fresh water supply; for about 2,750 ft. of usually 9⅝-inch, 40 lbs., casing set just above the "Brown Lime"; and for about 3,950 ft. of usually 7-inch, 24 lbs., oil string set above the "White Lime". On edge leases with absence of shallow oil and gas horizons the state now permits the use of only surface pipe and the oil string, thereby cutting the drilling time and reducing drilling costs by some $7,000 per well. All wells in Hobbs field were cemented by the Halliburton process, the standard practice approved by the state being to cement the surface pipe with 200 sacks, the intermediate string with 300 to 725 sacks, averaging 550 sacks, and the oil string with 300 sacks. Comparable casing and cementing state regulations apply to all of Lea County pools and to all wildcats.

Because of the presence of a very large volume of gas at around 3,750 ft. in the "Big Gas Pay" special mud control is necessary while drilling through this horizon. Plain water is usually used in drilling above the "Big Gas Pay", the shallower gas horizons carrying but small volumes of gas which are easily controlled by slush pumps. Just before reaching the "Big Gas Pay" mud weight is increased to 13½ or 15 lbs. per gallon and its consistency is carefully watched for low viscosity and slow settling rate to prevent it from being gas-cut or being thinned by high gravity oil from "Bowers Sand", which would permit expensive blow-outs. Native clay, producing 11½ to 12 lb. muds, is used as base for heavy muds and its weight and viscosity are adopted to Hobbs conditions by using baroid and suspensoid. The average cost of mud per well in Hobbs is estimated at $1,000, though in high pressure area the cost runs up to $3,000, and up to $25,000 if wells are allowed to blow-out with the attendant loss of mud; on edge leases the cost of mud is as low as $300 per well.

The wells in Hobbs are drilled into the limestone pay zones with water and are brought in by swabbing. In very porous areas of Hobbs wells while drilling in into the "White Lime" pay loose returns and often as much as 10,000 bbl. of fresh water has been pumped into such holes. In such cases the wells usually clean themselves without swabbing. Due to the cavernous nature of the producing formation coring is not a standard practice, because core recoveries are negligible, and in fact the size of wells can be judged by the percentage of non-recovery.

All wells in Hobbs produce through 3-inch tubing perforated in the bottom two joints and set about 20 ft. off bottom. Surface connections usually include high pressure Christmas trees, separators and tanks.

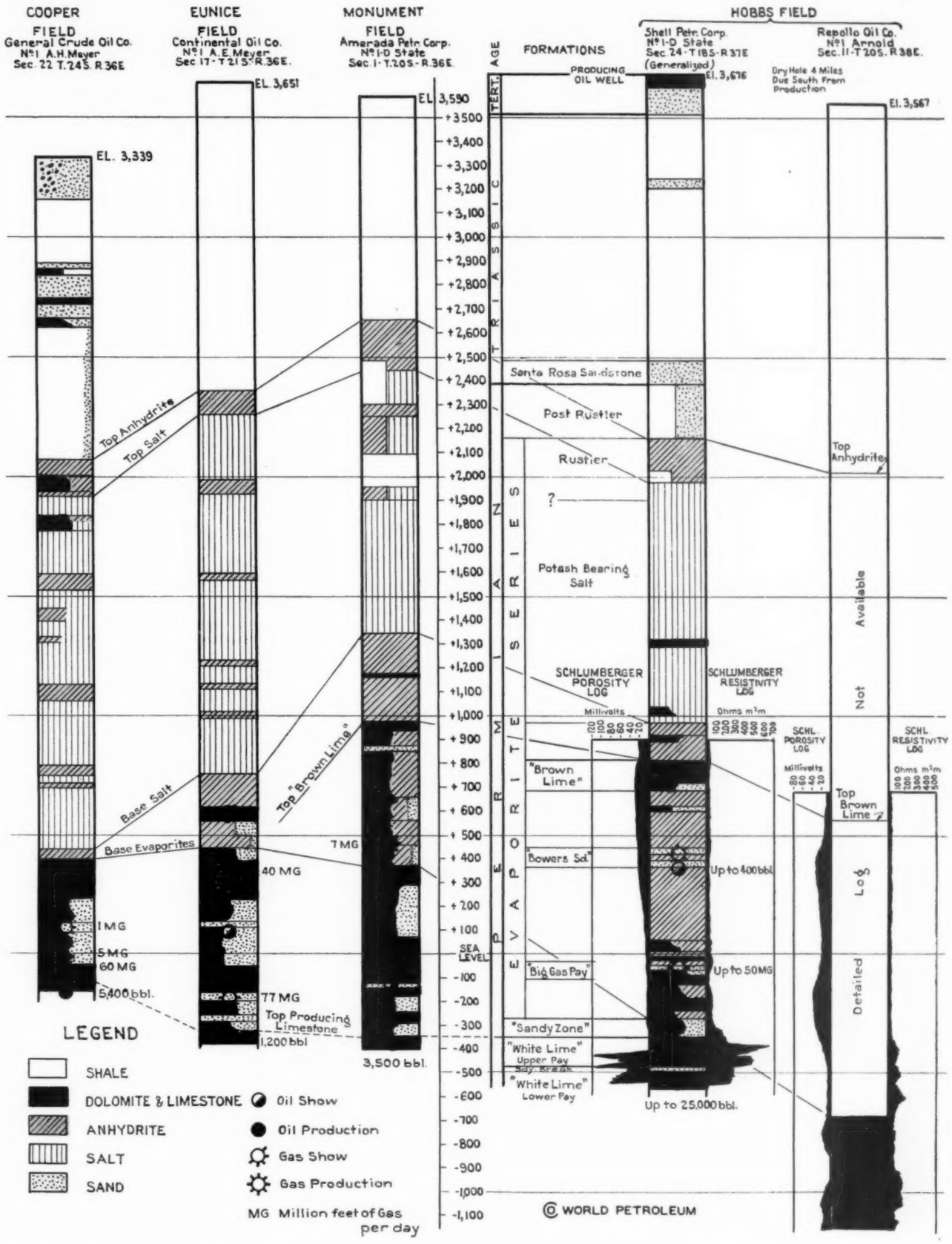
The cost of a completed and fully equipped well in Hobbs field averages around $42,500. Early completions in high pressure area cost as high as $60,000, while structurally low wells cost around $40,000; present costs are correspondingly $45,000 and $35,000. Drilling "contract" price is currently quoted at around $4.25 per foot. The total drilling development expense for 225 wells completed in Hobbs up to June 1, 1935, was therefore around $9,560,000. The 40-acre spacing is considered as entirely sufficient for complete recoveries in Hobbs field because of unusually porous limestone producing formation, because of effective edge water drive and more recently because of acid treatment. Elsewhere in Lea County drilling costs approximate those in Hobbs field, being between $40,000 and $50,000, the higher actual drilling costs being compensated by shallower depths. Thus the drilling investment in Lea County, outside of Hobbs, and including the more expensive wildcatting now approximates $10,000,000 for some 210 wells, including about 35 failures.

Production Practice and Costs

IN JUNE, 1935 practically all wells in Hobbs field were flowing naturally and only nine wells, or 4.0 percent of the total, were on the pump. All flowing wells produced through 3-inch, 9.3 lbs., tubing on both adjustable and positive chokes, production being taken, as required by the proration umpire, continuously during 24 hours, thus making withdrawals from the reservoir even and insuring gradual encroachment of water. From wells the oil flows into ground or elevated separators, then goes to flow tanks while gas is taken into gathering lines of the natural gasoline plants. At separator pressure of 40 lbs. the gasoline content of 1,000 cu. ft. of gas is 0.49 gallons, while crude oil tests 37.4 degrees A.P.I. gravity; and at atmospheric pressure in separators, 13.2 lbs. in Hobbs, the gasoline content of 1,000 cu. ft. of gas is 1.80 gallons, while the gravity of crude oil drops to 35.6 degrees A.P.I.; double trapping of gas is employed further to enrich it, increasing gasoline content to over 2.00 gallons per 1,000 cu. ft.

Mechanical lifting installations are of standard beam type equipped with 40 h.p. internal combustion engines; reversible counter shaft clutches; 11-ft. band wheels; steel rig fronts; 2½ or 3-inch tubing; ¾-inch sucker rods; and standard working barrels.

The current lifting costs of naturally flowing wells are directly related to the allowable production, since the field carries at all times a definite overhead. With a 35,000-bbl. per day field allowable, an average well allowable of 155.5 bbl. per day, the direct lifting costs per barrel are



Geologic Section of Lea County Oil Fields from Cooper to Hobbs, Showing Schlumberger Well Surveys in Hobbs.

estimated at three cents, which is probably the minimum cost for Hobbs since higher allowable is not considered advisable in view of water encroachment. Representative mechanical lifting costs in Hobbs field have not yet been determined because very few wells have been on the pump; tentatively mechanical lifting costs may be placed at around 15 cents per barrel. Total cost of production to May 1, 1935, has been therefore around $1,800,000.

Acid Treatment

ACIDIZATION has been introduced into the Hobbs field early in 1933, but was generally adopted only early in 1934. From its inception to January 1, 1935, 218 acid treatments were given to wells in the Hobbs field, many wells being treated two and three times, while a total of 311,000 gallons of acid was introduced into the pay formation in these treatments. This volume of acid dissolved theoretically 3,110,000 cu. ft., or 88,000 cu. meters, of limestone.

While the acid treatments have been highly beneficial and invaluable in many edge wells in Hobbs field, and elsewhere in Lea County, a large proportion of the acidization in the Hobbs field to date, where 8,000 to 15,000-bbl. wells were treated to increase their potentials and hence their allowables, was unnecessary and even harmful. More particularly, large and repeated acid injections without proper preliminary research work, "acid dumping," contributed locally to rapid water encroachment. The acidization was overdone in Hobbs field because proration in the field was and is based upon potential production and acid treatments stepped up potentials even of large wells as much as 100 percent. Once started, acidization could not have been very well discontinued unless the whole proration system was changed to straight 40-acre unit acreage allowable basis; moreover its effects were not yet fully understood in 1934.

The actual method of treating wells in Hobbs has been in general similar to acidization practice in the Michigan oil fields, the procedure having been described on pages 316–319 of the May, 1935, issue of WORLD PETROLEUM. In Hobbs the pumps forcing acid into wells have to work against considerably higher pressures than in Michigan, and some other refinements were also introduced in New Mexico. More particularly in order to prevent acid penetration below the oil water contact the pumping of acid into the wells is sometimes spread over a longer period of time. With a 2,000-gallon treatment 1,000 gallons may be pumped into the well at one time and 1,000 gallons one hour later; the same results are achieved by slowing up the pumps; or in some instances companies spread acidization over one week, giving in succession 1,000, 3,000 and 6,000-gallon treatments. Where acid treatments are given with the primary purpose of reducing gas/oil ratios, oil is pumped ahead of the acid into the tubing to protect the gas section of the limestone and then acid is pumped to react only in the oil zone.

Gas Conservation and Water Encroachment

GAS IN the Hobbs field occurs in a free state and in solution in crude oil. The free gas originally formed a very definite gas cap approximately above the −350 ft. sub-sea level, but subsequently the free gas was found to be expanding and migrating rather freely in the higher portion of the field, influenced by withdrawals of oil, by reduced reservoir pressures and consequent release of some gas from solution and also because of changes in local permeabilities due to acidization. Under original reservoir conditions, a pressure of about 1,510 lbs. and temperature of 100 degrees F., gas in solution tested approximately 800 cu. ft. per barrel at Hobbs atmospheric pressure of 13.2 lbs.; while under present reservoir pressure of around 1,320 lbs. gas in solution tests approximately 700 cu. ft. per barrel.

The gas/oil ratios in Hobbs are under satisfactory control, though over-acidization tended to increase them locally due to increased permeability. The original theory that acidization of limestone wells decreases gas/oil ratios has not been uniformly sustained, since such decreases were often only temporary and the acidized wells within a few weeks increased their gas/oil ratios to the former figure or higher. However, the study of the relationship of acidization and gas/oil ratios over the whole field to date, as indicated on the Progress Development Chart, does not show a marked increase in gas/oil ratios in the periods of greatest acidization. In general there is in Hobbs field a definite relationship between gas/oil ratios and the allowable crude oil production, and at around 35,000 bbl. per day the gas/oil ratio remains close to 1,250 cu. ft. per barrel, increasing to over 2,000 cu. ft. per barrel when crude oil production declined to 21,000 bbl. per day in December of 1932 as may be observed on Progress Development Chart. Under current production allowable of about 32,000 bbl. per day and the gas/oil ratio of 1,350 cu. ft. per barrel, some 650 cu. ft. of gas is withdrawn from the free gas supply of the field per each barrel produced. The individual very high gas/oil ratio wells are handled by cutting production to very small chokes, and, more effectively, by setting packers below the gas-oil contact.

The decline of reservoir (bottom-hole) pressures in Hobbs field has been very slow and up to June 1, 1935, the pressure declined from the original of around 1,510 lbs. to 1,320 lbs., a drop of 190 lbs. in five years, while some 58,000,000 bbl. of oil has been produced, or a decline of 3.27 lbs. per 1,000,000 bbl. produced. The progressive reservoir pressure maps of Hobbs field accompanying this article indicate equalization and uniform decline in pressures throughout the field, while the Progress Development Chart shows changes in the average reservoir pressures from the discovery of the field to this time.

TABLE 3

Gas Analyses in Hobbs Field*

	"Brown Lime" "Big Gas Pay" "Bowers Sand"	"White Lime" 1	"White Lime" 2
	%	%	%
H_2S	nil	2.27	1.05
CO_2	0.07	4.00	5.25
O_2	0.07	1.06	0.81
CH_4	58.00	52.19	63.30
C_2H_6	21.00	7.16	3.34
N_2	20.00	5.98	6.37
Propane		13.31	9.09
Isobutane		2.49	1.32
Normal butane		6.99	5.29
Pentanes and heavier		4.55	4.18

* From Hobbs Field, Lea County, New Mexico, by Ronald K. DeFord and Edwin A. Wahlstrom in A.A.P.G. Bulletin 1, Vol. 16, Jan. 1932.

The water encroachment in Hobbs field has been to date very gradual, as indicated on the accompanying map, and only within the past year have the structurally higher wells in the field become affected. The water first appeared on the southwest side of the field and gradually came up structure till 1934, when acid treatment apparently greatly accelerated the progress of water and at this time water encroachment is general on southwest, west and north sides of the field. Acid treatments, however carefully administered, have a definite tendency to act downward and this tendency has been responsible for much of the water encroachment in structurally high wells, more particularly as the size of individual acid treatments was stepped up from 1,000 gallons, to 2,000 gallons, to 4,000 gallons and recently to 6,000 gallons, with future plans calling for 10,000-gallon injections. The original water level in Hobbs field is thought to have been at −550 ft. sub-sea level. At this time the water level on the east, less porous, side of the field is still between −500 and −550 ft., while on the northwest, highly porous, end of the

Hobbs field showing water treating plant on the Gypsy Oil Company's West Grimes lease.

field water has encroached at this writing to about −380 to −400 ft., and elsewhere in the field it made its appearance at as high a level as −340 ft. It is hardly to be doubted that continued large 6,000 and 10,000-gallon acid treatments applied indiscriminately will further accelerate water encroachment, and may eventually result in higher lifting costs and even reduced recoveries. On the other hand it must be indicated that on the whole water production in Hobbs field has been to date a negligible factor, amounting currently to about 6 percent of crude oil production, though early in 1934 it actually reached 17.5 percent of crude oil output. The production of water was curtailed and in many instances eliminated by setting packers below the upper "White Lime" pay zone, and producing the affected wells from the lower "White Lime" pay zone which so far has not been seriously affected by water encroachment. In such instances careful acidization of the lower pay produced excellent results, because the two pays are separated by insoluble in acid sandy shale break and because the lower pay is much tighter than the upper, and without acidization does not produce satisfactorily. The water encroachment in Hobbs field, which has recovered to date 31.2 percent of its estimated ultimate recovery, cannot be considered as a threat, but rather as a helpful medium in flushing the producing limestone formation, unless water cones rapidly. Furthermore water does not form bad emulsions in Hobbs and is separated from oil by settling and heat treatments alone, in most instances at a cost not exceeding one to two cents per barrel, while the desert type of the country renders salt water disposal problem non-existent. In striking comparison it should be indicated that the Hendricks field in Winkler County, Texas, producing from similar limestone formation, is currently making 98 percent water and two percent oil, profitably producing at this time some 17,000 bbl. of oil per day.

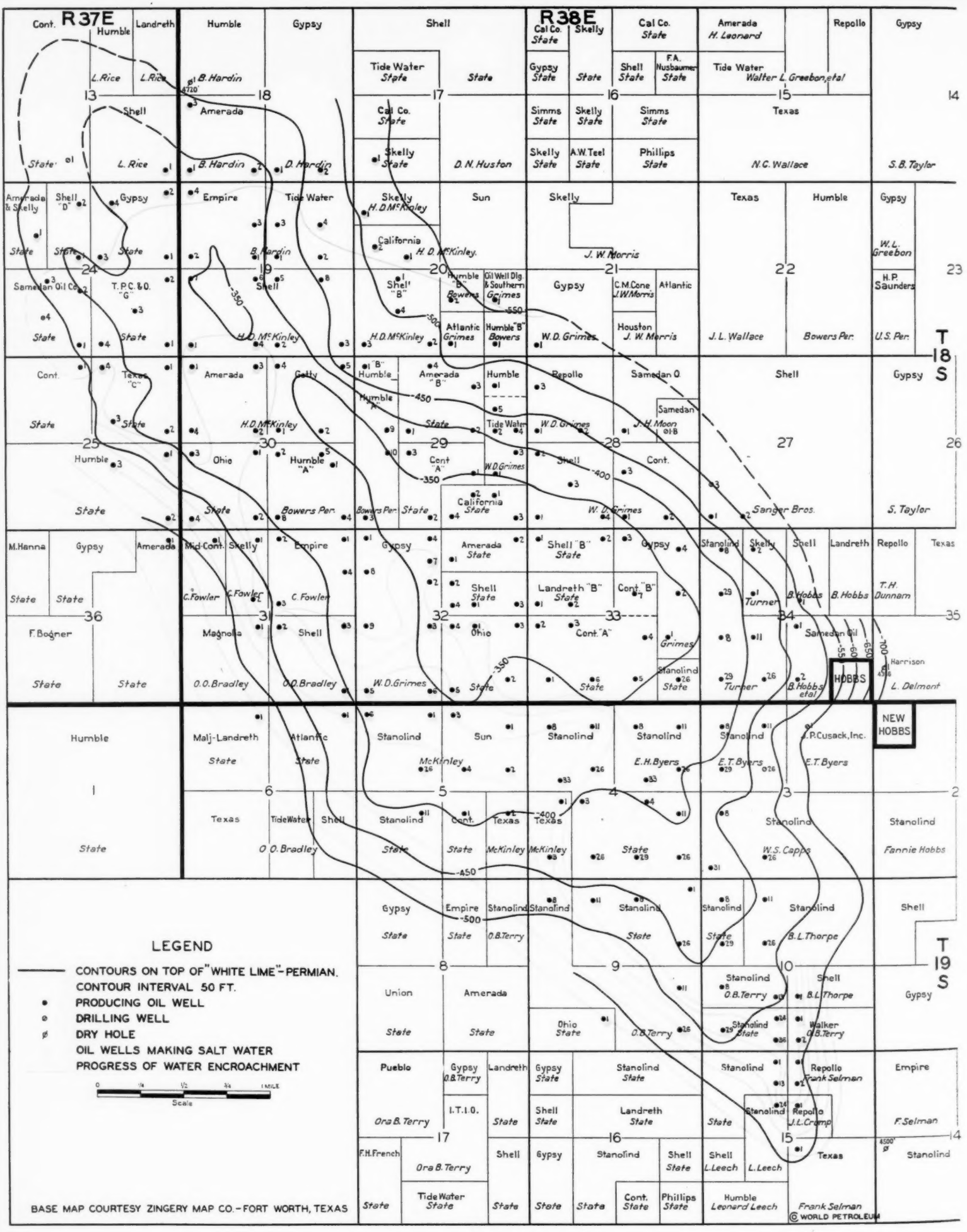
Balance Sheet of Development

WITH VERY conservative well spacing and effective proration, conducive to long flowing life, the companies in Hobbs field have been operating on the profit side of the ledger from the early life of the field. In most instances lease investments in Hobbs field proper have been small, but if the whole of the Lea County exploration and leasing campaign is included many more millions of dollars must be added for the search for oil and for the purchase and carrying of leaseholds. At one time almost the whole eastern portion of Lea County, some 1,400,000 acres, was under lease, and of this acreage some 650,000 acres are still carried.

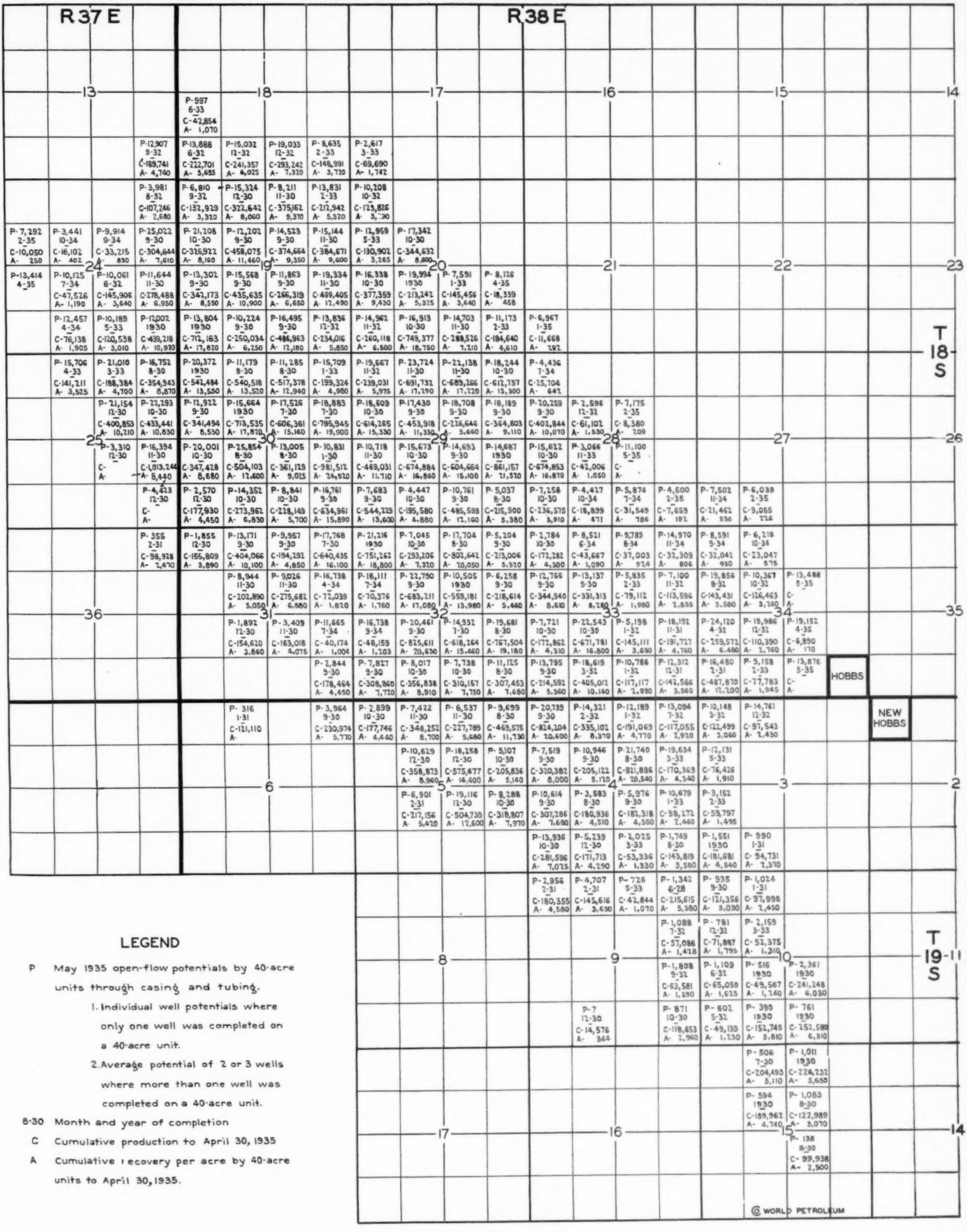
The total capital outlay for drilling and equipment of 225 completed oil wells in Hobbs field has been to date about $9,560,000. Because most of the capital employed for drilling was returned in about one year interest charges can be estimated at but $600,000, bringing the total capital expenditure for actual development to $10,160,000. A total of 57,238,964 bbl. of crude oil was produced to May 1, 1935, bringing from 10 cents to around $1.00 per barrel as indicated on the Progress Development Chart. The gross value of oil produced to that date in Hobbs is estimated at $34,370,000, or net, after deducting ⅛-th royalty, at $30,080,000. Production costs to date have been estimated at $1,800,000, indicating a net operating profit for Hobbs field of $18,120,000, an excellent result for five years of active operation under restricted production and in time of depression. Had the Hobbs crude oil prices remained steadily even at 75 cents per barrel the gross value of oil produced would have been $10,000,000 in excess of $34,370,000 actually received.

The estimated future recovery of some 120,000,000 bbl., as indicated earlier in this paper, should cost to produce about $8,400,000, basing the estimate on 3-cent cost for 66.6 percent of the ultimate to be produced by natural flow and 15-cent cost for the remaining 33.4 percent to be recovered by pumping. If the Hobbs crude oil averages $1.00 per barrel over the next few years the future recoverable crude will have a gross value of $120,000,000, or a net value of $105,000,000, after deducting royalty fraction. Thus a future profit of $96,175,000 is indicated for the Hobbs operators, after subtracting $425,000 for ten additional wells to be completed, or a total net profit over the whole life of the field of $114,295,000. In figuring the balance sheets and crude oil reserves of individual operators in Hobbs field from data given on Table 4 due attention must be paid to their present share of production, as being representative of the acreage they hold, and to location of the leases in the field in regard to areas most affected by water encroachment, though for an approximate estimate of reserves the present percentages of production alone may be considered as indicative of their share in reserves.

It is far too early yet to estimate reserves or even proven acreage of the several companies in newer fields of Lea County, but in general the most promising field, the Monument, is controlled principally by Amerada Petroleum Corporation and Gypsy Oil Company (Gulf), with Sun Oil Company, Shell Petroleum Corporation, The Texas Company, Repollo Oil Company (Consolidated) and Skelly Oil Company having some very promising acreage; the Eunice field will benefit principally Continental Oil Company and Gypsy Oil Company; the South Eunice, the Ohio Oil Company and the Texas Pacific Coal and Oil Company; while the Jal-Cooper-Lynn area is divided between several concerns with Phillips Petroleum Company, Pure Oil Company, Continental Oil Company and Humble Oil and Refining Company in the lead.



Subsurface Structure and Development Map of Hobbs Field Showing Progressive Water Encroachment.



LEGEND

P May 1935 open-flow potentials by 40-acre units through casing and tubing.

1. Individual well potentials where only one well was completed on a 40-acre unit.
2. Average potential of 2 or 3 wells where more than one well was completed on a 40-acre unit.

8-30 Month and year of completion

C Cumulative production to April 30, 1935

A Cumulative recovery per acre by 40-acre units to April 30, 1935.

Production Map of Hobbs Field Showing Well Potentials, Dates of Completion, Recoveries Per 40-Acre Units and Per Acre to April 30, 1935.

TABLE 4

Accumulated Production, Daily Current Allowable Production and Oil Wells as of May 1, 1935, in Hobbs Field by Companies and Totals

Company	Accumulated Production bbl.	May, 1935, Allowable bbl.	May, 1935, Allowable % of Total	Oil Wells
Stanolind Oil and Gas Co.	8,813,215	5,465	17.73	50
Shell Petroleum Corporation	7,664,958	4,248	13.78	31
Gypsy Oil Company	4,611,164	3,110	10.09	19
Amerada Petroleum Corporation	5,835,269	2,585	8.37	15
Continental Oil Company	3,964,873	2,287	7.41	14
Humble Oil and Ref. Co.	6,028,292	2,191	7.09	15
Ohio Oil Company	3,321,377	1,464	4.74	10
The Texas Company	2,385,248	1,416	4.58	8
Tidewater Oil Corporation	2,573,099	974	3.15	9
Samedan Oil Company	160,164	972	3.15	4
Getty Oil Company	2,118,998	768	2.48	4
Skelly Oil Company	949,982	751	2.43	6
The California Company	1,177,027	602	1.95	6
Texas Pacific Coal & Oil	984,150	582	1.89	4
Sun Oil Company	1,517,064	558	1.81	4
Repollo Oil Co (Consol.)	838,871	515	1.67	6
Landreth Production Co.	797,363	390	1.26	3
Atlantic Oil Prod. Co.	519,320	271	0.88	2
Oil Well Drilling Co.	18,339	124	0.40	1
Magnolia Oil Co.	154,620	74	0.24	1
Midcontinent Petrol. Corp.	155,809	73	0.24	1
Walker Oil Corporation	252,580	64	0.21	2
	57,238,964	30,859	100.00	223

Gasoline Plants, Pipelines and Markets

TWO GASOLINE plants are operating in Hobbs field. Phillips Petroleum Company's plant is currently processing around 17,000,000 cu. ft. of natural gas per day in its plant equipped with 14-190-h.p. direct connected Clark compressors and having a capacity of 23,000,000 cu. ft. per day. The Phillips plant recovers around 28,500 gallons of natural gasoline per day, averaging 1.67 gallons per 1,000 cu. ft. Shell Petroleum Company's plant is now processing about 9,900,000 cu. ft. of natural gasoline per day, the plant having a capacity of 12,000,000 cu. ft. per day and being equipped with seven 165 h.p. direct connected Bessemer compressors and three 225 h.p. direct connected Miller compressors; Shell plant produces around 23,000 gallons of natural gasoline per day, averaging 2.30 gallons per 1,000 cu. ft. Practically all gas produced in Hobbs field is processed by the two plants; the residue is blown into the air and burned, with the exception of a small volume consumed in Hobbs and Lovington.

Four trunk pipelines (one 10-inch and three 8-inch) serve Lea County pools, of which three, completed in 1930, are connected with the Hobbs field. Shell Pipe Line Company's 10-inch line serves Hobbs field and passes near all other fields of Lea County; its terminal is Houston, Texas. Shell Pipe Line Company is currently the principal purchaser in Hobbs, handling some 23,840 bbl. daily. Humble Oil and Refining Company's 8-inch line serves both the Hobbs and other Lea County fields, currently running 2,455 bbl. daily from Hobbs and 5,700 bbl. daily from other pools in Lea County. The terminal of Humble's line is Harbor Island, Texas, on the Gulf Coast near Corpus Christi. The Texas Pipe Line Company's 8-inch line is not connected with Hobbs field, serving Lea, Eunice and other fields of Lea County, running currently some 12,200 bbl. daily to its Port Arthur, Texas, terminal. The Atlantic Pipe Line Company's 8-inch line serves Hobbs field alone, running at this time around 4,500 bbl. daily to Port Arthur, Texas, terminal. All these pipelines range in length from 500 to 600 miles. In general New Mexico crude oil is mixed in transit with crudes from West Texas fields and does not preserve its identity for refining operations. It is refined in the Gulf Coast and Eastern Atlantic refineries.

TABLE 5

Analysis of Typical Crude Oil from the Hobbs Field

A.P.I. gravity	36.25
Specific gravity	0.843
Sulfur content, percent	1.15
Viscosity, Seybolt Universal	40/100
Color	black
Gasoline and Naphtha content:	
Percent	37.0
A.P.I. gravity	59.0
Octane value	57.0
Sulfur content, percent	0.2
Kerosene distillate (non-commercial):	
Percent	8.0
A.P.I. gravity	38.0
Sulfur content, percent	0.7
R.O. viscosity	475
Flash-Abel	150 plus
Gas Oil:	
Percent	15.0
A.P.I. gravity	30.0
Sulfur content, percent	1.25
Flash-Abel	168
Cracking Stock:	
Percent	25.0
A.P.I. gravity	22.8
Sulfur content, percent	1.94
Bottoms (incl. loss of 0.5 percent):	
Percent	15.0
A.P.I. gravity	19.0
Sulfur content, percent	1.37

TABLE 6

June, 1935, Allowable Production from Lea County Pools

Hobbs	31,614 bbl.
Eunice	8,798 bbl.
Cooper	6,887 bbl.
Jal	4,782 bbl.
Lea	1,388 bbl.
Monument	296 bbl.
Total	53,765 bbl.

Geology

BECAUSE the stratigraphy of Lea County is closely related to the general structural conditions and the geologic history of Eastern New Mexico and West Texas all these features will be discussed in this paper together. It must be definitely stated, however, that the geology of southeastern New Mexico and West Texas presents many difficult problems due to lack of deep control wells and detailed sample work, and it is stressed that the views of this summary are those of the author, and quite definitely do not represent the opinion of any one school of thought, if, indeed, there is any agreement on the problem at all.

The major geologic structural features in the area under discussion include:

(1) The positive element of Central Basin Platform of West Texas, which covers roughly Crane, Ector, Andrews, Gaines and eastern parts of Winkler and Ward Counties of Texas and southeastern part of Lea County, New Mexico. The Central Basin Platform appears to be shaped somewhat like a saucer with its edges elevated above the massive of the Platform, although in the interior of the Platform high areas along definite trends probably also exist. Numerous major and secondary fields are related to the elevated edge of the Platform, of which the south and west sides have been most actively explored. All fields of Lea County east of Range 36 East are supposed to be in that classification.

(2) The "Capitan" reef which enters New Mexico north of Hendricks field, includes the Jal, Cooper and Lynn fields, which will probably eventually connect, swings west to include Lea and Getty pools and then emerges near Carlsbad where the exposed reef is formed by the "Carlsbad" limestone, which may be correlated with the "Brown Lime" of eastern Lea County. Further to the southwest the reef continues to the Guadalupe point in Culberson County, Texas, and aerial photograph No. 2 shows the "Capitan" reef at that point as it plunges northeastward in the direction of

Carlsbad. The limestone forming the Guadalupe point is known as Capitan, and hence the buried extension of the reef has been named after this most prominent outcrop. The "Capitan" reef forms the southwest edge of the Central Basin Platform, from the Pecos Valley field in Pecos County, Texas, to Lynn field in Lea County, a practically unbroken chain of fields.

(3) The Delaware deep sea basin which is encircled on the north by the "Capitan" reef and which covers south portions of Eddy and Lea Counties, New Mexico, and extends southward into Texas.

(4) A narrow synclinal belt with minor negative relief extending northwestward and westward from the synclinal area between Monument and Eunice field, and limited on the south by the "Capitan" reef and on the north by the Artesia-Maljamar positive structural trend.

(5) The Artesia-Maljamar anticlinal trend which roughly parallels the "Capitan" reef about 15 miles to the north. The Artesia-Maljamar trend developed some secondary pools, Artesia, Grayburg, Jackson and Maljamar, in the localities where its south dip is steep.

(6) The vast West Texas Permian ("White Horse") interior sea basin which encircles on the north and east sides the whole area under discussion, and whose sedimentation is radically at variance with the sedimentation of the Delaware deep sea basin, with the intermediate area, the Central Basin Platform, showing again a different geologic section which grades laterally into Delaware basin section westward and interior sea basin of West Texas eastward.

The age of all of the above structural features was purposely omitted in the first brief review. All wells in the area penetrated only into the Permian and the nearest Ordovician tests (very few) are some 100 miles away, hence definite data to interpret the structural conditions not only of the basement complex but even of lower Permian are absent. It may be quite tentatively presumed, however, that some of the indicated major features had their origin very early in the geologic history, this presumption having in mind more particularly the Central Basin Platform with some major positive trends superimposed upon it; the Delaware deep sea basin, a major depression; and the "Capitan" reef which was probably developed on a positive structural element.

Briefly, all formations in the Hobbs field proper are of Tertiary, Triassic and Permian age, as is shown on the Geologic Section.

The Tertiary is represented by some 200 ft. of buff to pinkish sand with its upper 50 ft. grading into very hard limestone, "caliche." Fresh water is encountered in large volume at about 60 ft. in the Hobbs.

The Triassic system (Dockum group) is represented by 1,060 ft. of dark red shales and clays, occasionally sandy, and by 110 ft. of red calcareous and micaceous, water bearing, Santa Rosa sandstone.

The Permian system in Hobbs field for easier reference may be subdivided into:

(1) About 200 ft. of Post-Rustler sandy red shales.

(2) Anhydrite above salt section, Rustler formation, composed of about 100 ft. of fairly pure anhydrite, which is used as the first structural marker.

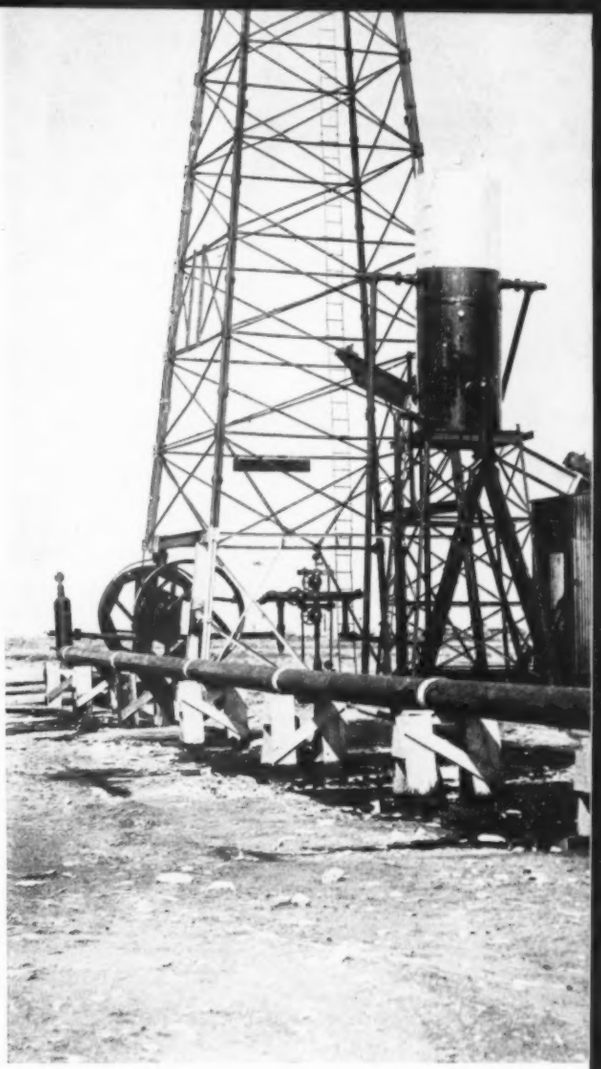
(3) Potash bearing salt section, composed of some 1,000 ft. of salt beds, which are interbedded with thin anhydrite beds and thin layers of red and gray shales. Pockets of non-inflammable gas are commonly encountered in the salt section.

(4) Anhydrite below salt and above "Brown Lime" is represented by about 150 ft. of anhydrite containing considerable amount of easily caving red shales and few stringers of salt.

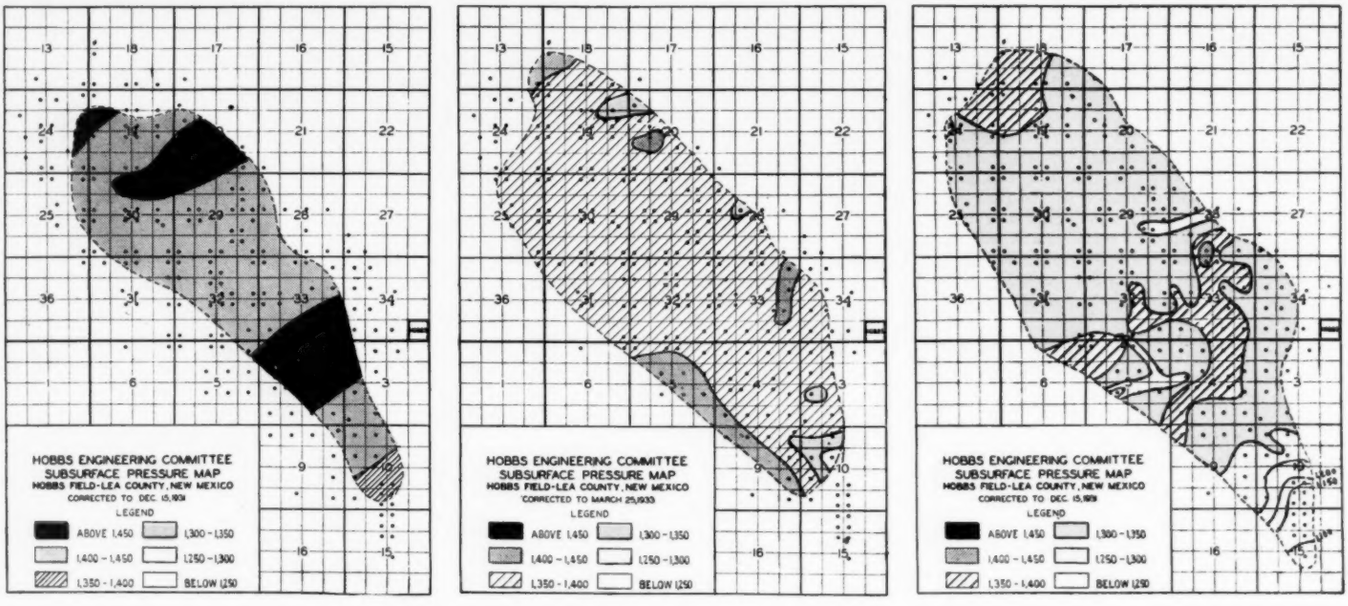
(5) "Brown Lime" is very easily recognizable in drilling and is an important key bed for structural mapping in Hobbs field and throughout Lea County. "Brown Lime" consists in Hobbs of some 30 ft. of grayish brown limestone with little anhydrite, and it shows first inflammable gas in very small volume.

(6) Mixed zone from base of "Brown Lime" to top of "White Lime." This zone varies greatly in Lea County pools as can be noted from the accompanying Geologic Section, with definite correlations still being in dispute and a matter of personal opinion. Only Hobbs field section is reviewed here. Some 250 to 275 ft. of chiefly anhydrite follow the "Brown Lime", excepting a thin gray sand body which underlies immediately the "Brown Lime" and also yields small showings of inflammable gas. "Bowers Sand" occurs between 3,175 and 3,220 ft. in Hobbs, and is the first oil horizon in the field; although not yet commercially exploited, it is represented by a 50 to 70-ft. zone of lenticular sands intermixed with anhydrite and some shale and limestone, and has produced as high as 400 bbl. of 40 gravity oil and several million cu. ft. of gas per day within the 400-ft. "White Lime" contour line, though when developed in the future the "Bowers Sand" production is not likely to cover the whole area within that contour line due to the lenticular character of the sand bodies. Some 450 ft. of predominantly anhydrite with little limestone at base underlie the "Bowers Sand", at which depth, around 3,700 to 3,750 ft., the "Big Gas Pay" section is encountered; it is composed of sand and sandy limestone and showed as high as 50,000,000 cu. ft. of gas per day under an estimated reservoir pressure of 1,500 lbs. The gas in the "Big Gas Pay" is underlain by salty water, and its productive limits are similar in general to those of "Bowers Sand." Some 200 ft. of anhydrite and limestone beds underlie the "Big Gas Pay" and these, in turn, are followed by about 100 ft. of "Sandy Section" composed of limestone, calcareous sandstone and some calcareous shale with some erosional limestone material from the "White Lime" section. "Sandy Section" carries small oil shows.

(7) The top of "White Lime" is encountered at from 3,950 to 4,200 ft. in Hobbs. Its upper 10 to 30 ft. are composed of dense, blue-gray pyritic dolomitic limestone which forms the caprock over the main oil producing zone in the field. This first producing zone of "White Lime" is composed of soft, very porous to cavernous dolomitic limestone. Its cavernous nature has been definitely established by the loss of returns in rotary drilling, by the sudden dropping of tools in cable drilling or drilling without any apparent resistance with rotaries and by few fragmentary samples suggestive of large caves. "White Lime" in Hobbs field is around 200 ft. thick, apparently greatly increasing in the northwest end of the field to as much as 500 ft. The upper zone varies in thickness in the field from 85 ft. to around 150 ft., and is the most prolific producing zone in the field, it is in turn subdivided into two pays, which, however, are probably interconnected. The upper zone is underlain by 10 to 20 ft. of light grayish green sandy shale, which is impervious, below which is the lower pay of the "White Lime" which is less porous, less prolific and which is composed of dark dolomite, the lower pay varies from 110 ft. in thickness to as much as 400 ft., thickening also in the northwestern direction in the field. Very black carbonaceous shale is a minor constituent of the "White Lime." In the few wells that were cored in the



Continental Oil Company's No. 1 State in section 5,–T19S–R38E showing well connections, separator and "knock-out" water treating box.



Subsurface progressive reservoir pressure maps of Hobbs field.

"White Lime" stylolitic pressure structure in dolomite has been definitely demonstrated to exist, as is also the case with the Dundee limestone in Michigan, as was described and illustrated on page 323 of May, 1935, issue of WORLD PETROLEUM.

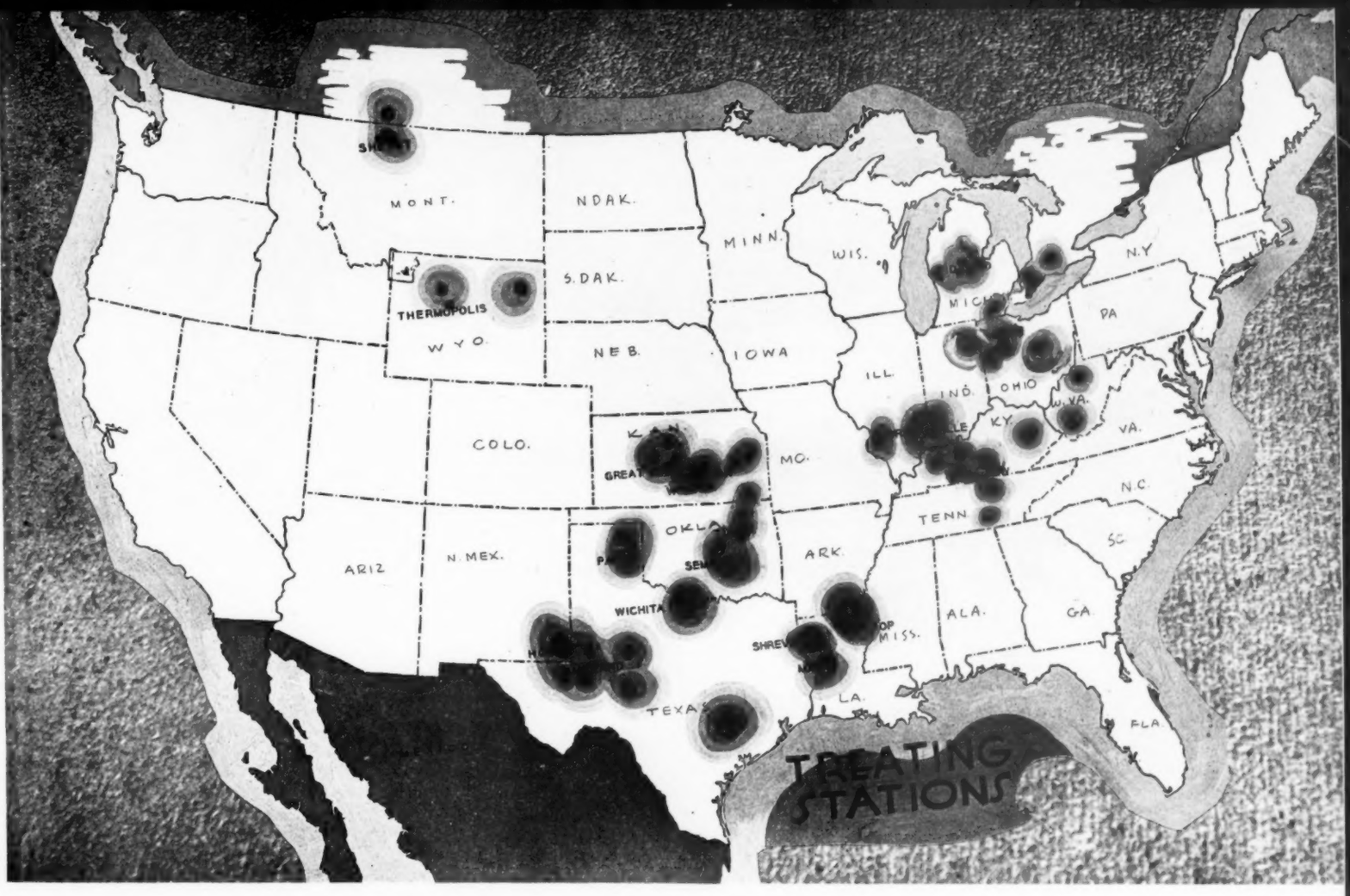
Three definite porous and saturated zones in the "White Lime" are also proven by the Schlumberger electrical survey of Shell Petroleum Company's No. 1-D State which is reproduced on the Geologic Section. Actual pay zones are thought to average around 20 ft. each. The intermediate sandy shale break is impervious to water and is insoluble by the acid and accordingly it developed into an excellent shield for the lower pay. While originally water level was probably at −550 ft. in both pay zones, the greater rate of production from the upper pay resulted in a marked advance of the water in that pay to as high as −400 ft., or even higher, while the water level in lower pay advanced but little, and in consequence wells producing too much water from the upper pay have been successful in setting packers in the sandy break and producing clean oil from lower pay only.

A very important feature of the "White Lime" production in Hobbs is the fact that the producing dolomite is cavernous on top of the structure, fairly porous on the flanks and very slightly porous off structure, as is excellently illustrated on the Geologic Section by the Schlumberger survey of the Repollo Oil Company's dry hole four miles due south from the field, in which the "White Lime" porosity reached but −20 millivolts as compared with −120 millivolts in the field proper. The development of porosity in the "White Lime" is probably due to uplift and consequent weathering, while cavernous nature of the porosity may be accounted perhaps by old tide level. The origin of oil is thought to be in the "White Lime" itself and within a limited area around the field, as is indicated and suggested by the black carbonaceous shale in the dolomite and by the fact that dolomite becomes dense off structure. Also the sandy shale break in the middle of the "White Lime" is suggestive of an uplift at that time. As shown by R. K. DeFord and Edwin A. Wahlstrom in their review of Hobbs field in the A.A.P.G. BULLETIN 1, Vol. 16 the folding at Hobbs, with its closure of around 250 ft., has been progressive during Permian time, with nearly one-third of the folding taking place after the deposition of "White Lime" and before the deposition of "Brown Lime" and nearly two-thirds subsequent to the deposition of the Rustler formation.

The scope of this article does not permit even a very general discussion of the radical changes in sedimentation in the oil fields of Lea County, but very briefly, and referring to the Geologic Section, the reef type of stratigraphy, as represented by the Cooper field log, differs greatly from the section in Hobbs field, which represents a major structural feature on the Central Basin Platform itself or on its northern flank, some 25 miles due northeast from the "Capitan" reef phase. Gradual change from the reef type to the Hobbs type of section can be observed on the Geologic Section, even though only 4 logs are presented. Quite apparently east of the reef and toward the interior sea depositional basin of lagounal type the dolomitic beds of the reef phase gradually change into the section carrying predominantly anhydrite. Potash bearing salt beds appear to be quite consistent but regionally they steadily thin eastward. "Brown Lime" horizon, which has been correlated with the "Carlsbad" limestone, can be carried across Lea County with reasonable continuity, but it definitely does not give a structural impression of the county as a whole, more particularly in its relationship to the interval to the producing limestone formations in the various fields. Local producing areas should be contoured preferably on the individual most consistent key beds. In Jal, Cooper and Lynn fields the producing dolomitic limestone is porous on its steep basinward dip side and dense and nonproductive on the higher parts of the structure, a typical reef condition. The recently discovered Monument field is thought to be of the type similar to Hobbs and it will probably develop maximum porosity on the top of the structure, while Eunice field may represent a transition phase. From Jal to Hobbs field the producing limestone formation stratigraphically is probably progressively lower.

Conclusions

BECAUSE of the distance of the New Mexico oil fields from the great Mid-Continent oil fields there has been a tendency to underestimate the developments in Lea County, more particularly in circles not in direct touch with the producing branch of the oil industry. The Lea County pools have recovered to January 1, 1935, some 64,000,000 bbl. of crude oil from around 400 oil wells, while an additional reserve of some 220,000,000 bbl. has been proven; the total productive area of Lea County proven to date is currently estimated at about 45,000 acres. During the remainder of 1935 and in 1936 many more wells will be drilled in Lea County pools greatly extending them, while new discoveries are almost certain to be made. Thus potentially a major oil province of the United States is being actively developed to add to the diminishing reserves of the country.



Map of Dowell treating stations in the United States.

Increasing Crude Production 20,000,000 Bbl. From Established Fields

By John J. Grebe, D.Sc. and Sylvia M. Stoesser, Ph.D.

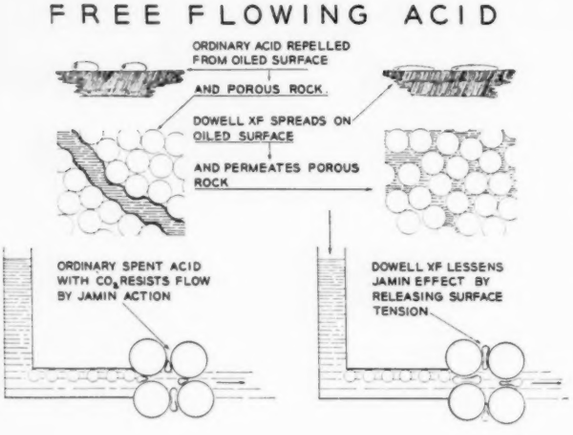
Illustrations by Millard J. Hooker

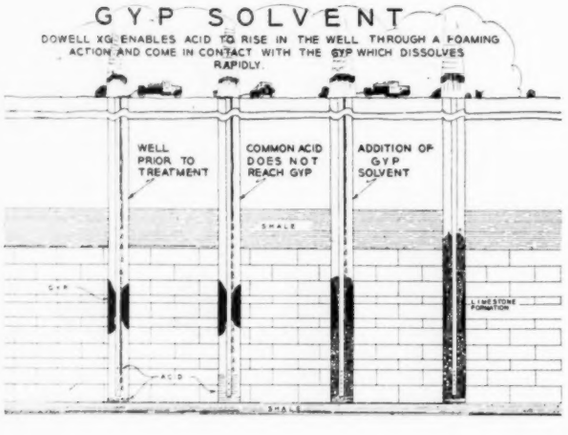
COMMERCIAL acidization of oil and gas wells although non-existent four years ago, now is practiced over the entire country. Approximately 6,000 oil and gas wells have been treated by Dowell Incorporated, to give an average increase in production of 412 percent. In central Michigan alone one-sixth of the total oil production is the result of acid treatments, thus indicating a net gain of $5,000,000 to the oil companies. An estimate over the whole country, as calculated from data supplied by the Dowell treating stations, shows an increase of more than 20,000,000 bbl. equivalent to $20,000,000. Thus, the interest which has been displayed in the history and development of this industry is entirely warranted. The first published recognition of the importance of this process was made in WORLD PETROLEUM in December 1932, by Basil B. Zavoico.

That The Dow Chemical Company should investigate acidizing wells and demonstrate its practicability follows logically from their background. It is a chemical company which obtains its basic raw materials from brine wells.

Treating truck and trailer which serves as a field laboratory; below, interior

Dowell field station at Midland, Texas with acid trucks lined up ready to service wells.


FREE FLOWING ACID
ORDINARY ACID REPELLED FROM OILED SURFACE
AND POROUS ROCK
DOWELL XF SPREADS ON OILED SURFACE
AND PERMEATES POROUS ROCK
ORDINARY SPENT ACID WITH CO_2 RESISTS FLOW BY JAMIN ACTION
DOWELL XF LESSENS JAMIN EFFECT BY RELEASING SURFACE TENSION


GYP SOLVENT
DOWELL XG ENABLES ACID TO RISE IN THE WELL THROUGH A FOAMING ACTION AND COME IN CONTACT WITH THE GYP WHICH DISSOLVES RAPIDLY.
WELL PRIOR TO TREATMENT
COMMON ACID DOES NOT REACH GYP
ADDITION OF GYP SOLVENT
SHALE
GYP
LIMESTONE FORMATION
ACID
SHALE

The chemical treatment of a well to increase the production of brine, oil, or gas, as the case may be, would naturally be developed by a company which deals with both chemicals and wells.

The use of acid to increase oil production is based on the fact that the acid dissolves the rock and enlarges the pores and openings. As early as March 17, 1896, a patent was issued to Frasch describing the use of hydrochloric acid in wells with limestone pay formations. The late Dr. Herbert Dow, very early in his career, lowered bottles of acid into brine wells for the purpose of increasing their production. The results were not satisfactory largely on account of the corrosion incurred and the expensive materials required to protect the metal equipment. Since that time various producers have attempted to apply this idea. In 1928, when the problem of brine disposal, as well as increased production of natural brine, became important, the use of acid was again attempted. To be at all feasible, however, it was found that the acid should contain an inhibitor which would prevent corrosion of the casing, tubing and other metal parts of the well.

Many inhibitors were tested. In the first trials arsenic acid was used as an inhibitor. Later copper salts were used with the arsenic to avoid the formation of calcium arsenate precipitate which might cause trouble in the pores. Since then organic inhibitors have been found to be far superior, and have replaced inorganic materials. The practicability and value of acid treatments in oil wells were demonstrated first when the Dow Chemical Company, together with The Pure Oil Company, successfully treated the Pure Oil Company's well, Fox No. 6, in the Greendale Pool, Michigan, in February, 1932.

Great advances have been made since this first treatment—advances in technique as well as in materials. It is recognized now that every well is a problem in itself, and must be analyzed individually in order to obtain the best results. It is the purpose of this article to show some of the many variable factors that have to be taken into account when considering the acidizing of wells, and some of the methods and materials that have been developed to meet the multiplicity of situations.

The flow of oil into a well is dependent upon several factors: the number and size of the pores in the face of the well, the pressure behind the oil, the physical characteristics of the oil itself, etc. Similarly, the flow of gas, oil, brine, or any solution to be put into a well, is controlled by the same factors.

Theoretically, it is possible to increase the size of the pores in all acid soluble rock formations. In practice, however, difficulties arise in transporting the acid to the bottom of the hole without damage to the well, particularly the casing seat, in directing its flow entirely into those pores for which it is intended, in obtaining complete reaction, and in withdrawing completely the spent solution from the formations so that oil may again pass through the entire treated area and reach the well.

The method of confining the acid under pressure, developed by R. H. Carr of the Pure Oil Company in which a column of oil is used to fill the casing, is indispensable for accurate control of the level at which the acid is to enter the rock in addition to protecting the casing seat.

For ordinary limestones, Dowell X, an inhibited hydrochloric acid is an active solvent, while hydrochloric acid fortified with other acids is used on the more difficult silicious dolomites that are slow to react or sometimes nearly inert to ordinary acid.

To promote contact of the acid with surfaces that are greasy or of such extremely fine porosity that ordinary aqueous solutions will not enter the pores or wet the wall surface, a low surface tension wetting agent is added to the acid. This is known as Dowell XF.

Various agents are employed which prevent the treating solutions from entering other than the areas to be treated. Water in the bottom of the hole, at the pay or above, is shut off permanently or temporarily by the use of blanket and water seal. Crevices and large pores in the producing area are all plugged for a limited time by Fillers "A" and "B", so that pressure may be applied to force acid into relatively tight portions of the rock in search of new producing areas.

The substances used to increase the fluidity of treating agents in general affect the density, viscosity, and surface tension of the treating solutions in their active and spent states. They are particularly valuable in fields with low rock pressure where the well may be unable to purge itself of the usual spent treating solution, which requires a relatively high pressure to force it from the formation.

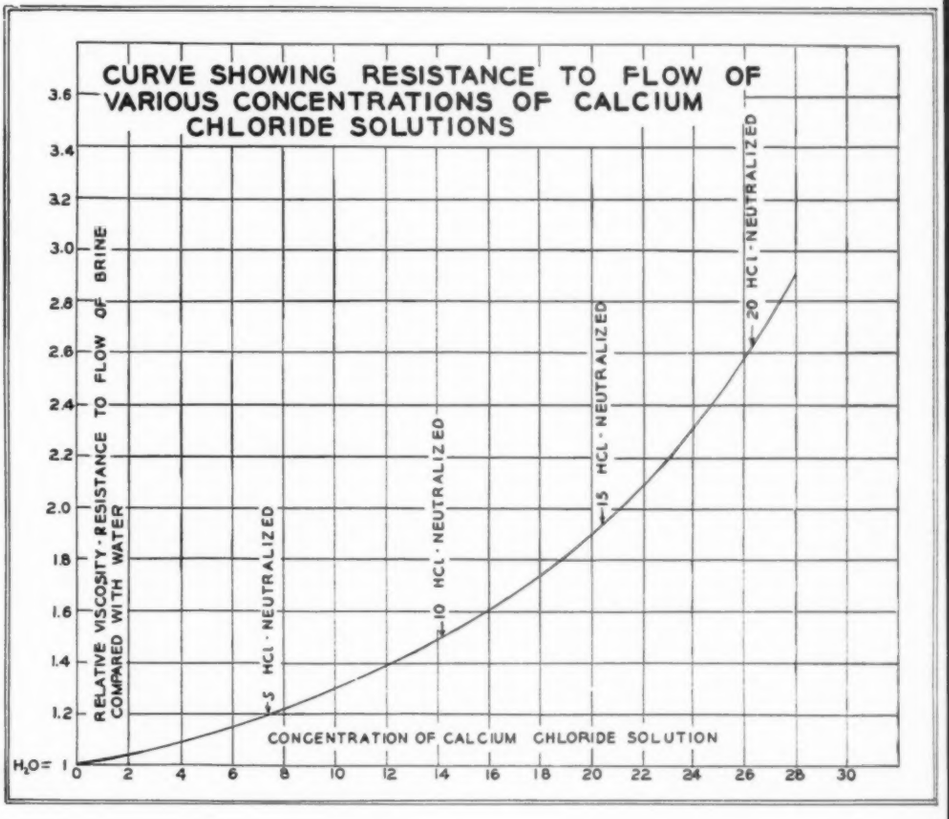
The variety of treating procedures is even greater than the number of materials used; and in some instances mechanical methods, such as Jamin Choke and gas repressuring, replace some of the chemical agents.

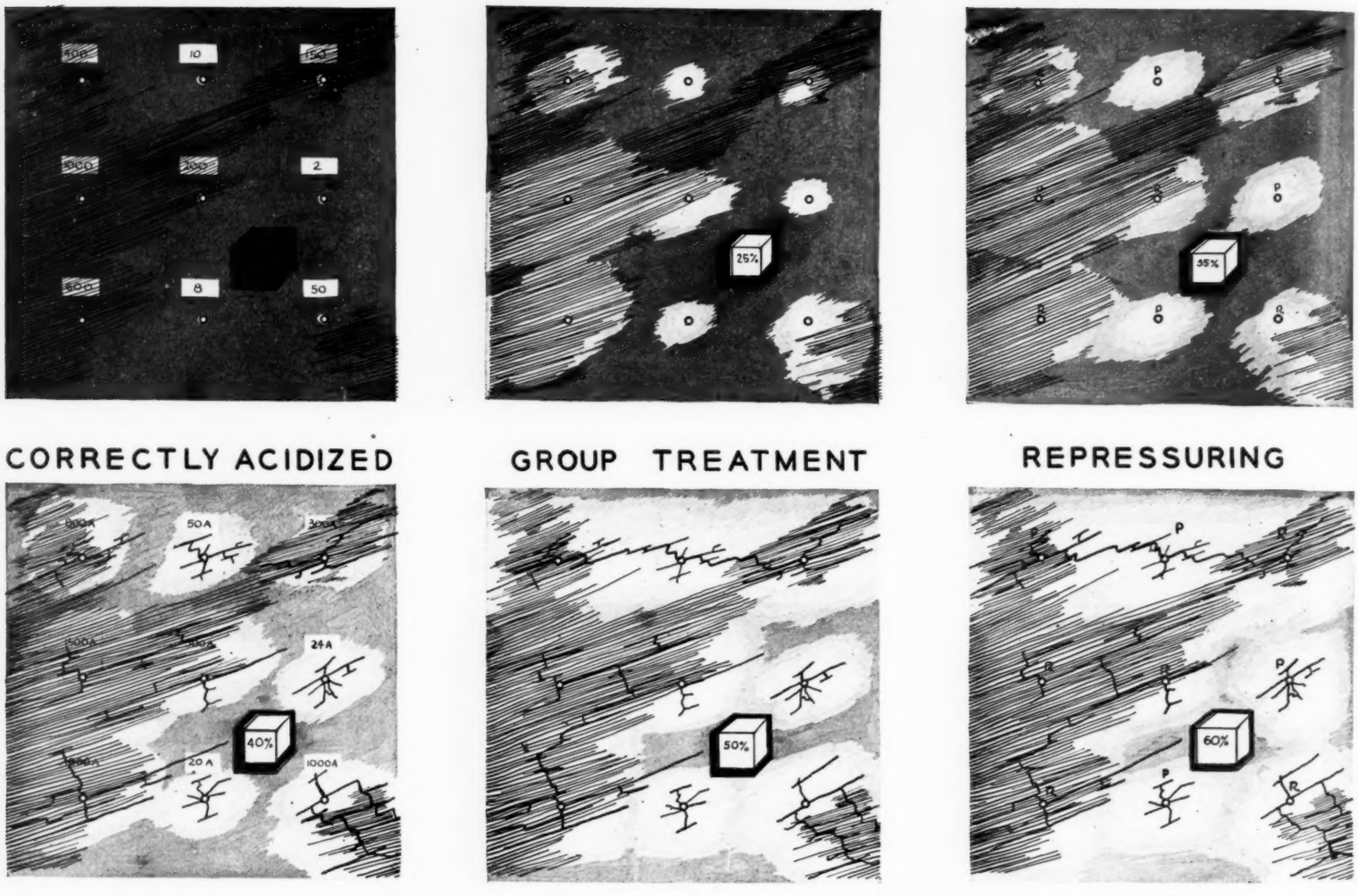
The casing may be oil or gas loaded, or a packer may be used to confine the acid to the lower part of the hole. Oil is being replaced in some cases by gas as the medium for forcing the acid into the formation. The fluid properties of gas are better than those of dead oil. Furthermore, the gas surges the acid back and forth in the rock so that it cuts channels rather than pockets. The releasing of the gas pressure suddenly after the acid reaction, forces any obstructing materials from the acidized well zones.

The illustrations and discussions which follow give a more detailed description of the agents and methods now employed by Dowell Incorporated and some of the new ones being introduced at the present time.

THE MAP of the treating stations now established in the United States shows the rapidity with which this work has spread over a large portion of the country. The shaded portions are the areas which are easily reached

A pump and compressor truck for acid treating wells.





from the treating stations shown by dark circles. Additional stations will undoubtedly be necessary in the future, particularly in those areas where new methods of treatment will make it possible to apply chemical service to types of pay, such as sand formations, not covered by present practice.

The early equipment used for treating wells consisted of an assembly of tanks and pumps on top of standard platform trucks. As the business became more stable and it was realized that there would always be a need for specialized equipment for chemical service of oil and gas wells, special trucks, pumps, and tanks were built.

Hydraulic pumps of greater strength and rigidity and lighter in weight were and are being developed, using a Dowmetal base and frame, which made it one-third lighter than even a similar sized aluminum casting.

The early field stations were designed to have the maximum amount of flexibility and portability in order to follow the locations requiring service. At first it was desirable to have the station entirely on railroad cars. A train consisted of a caboose for office purposes; a box car with electric lighting equipment and compressor, and for the storage of solid and drum lot materials; two steel tank cars for storing the inhibited hydrochloric acid of the maximum concentration used for well work; and one rubber lined tank car for transporting concentrated hydrochloric acid from the source to the field station. After finding out where more permanent stations were needed, constructions of the Midland type shown on page 474 became desirable. At the present time most of the acid is stored in 10,000-gallon welded steel tanks, as shown in the picture.

The best proof one can offer of the safety of the acid treatment in connection with the metal parts of the well is given in the fact that these storage tanks are made of the same type of steel as the well equipment, and normally withstand the corrosive action of the Dowell X acid for at least two years. It is important for the prospective user of chemical service to know how the acid is stored—since there is a large difference between poorly inhibited acid and that which is thoroughly inhibited. The latter will not lose its protection due to extraction on contact with oil, contact plating or oxidation.

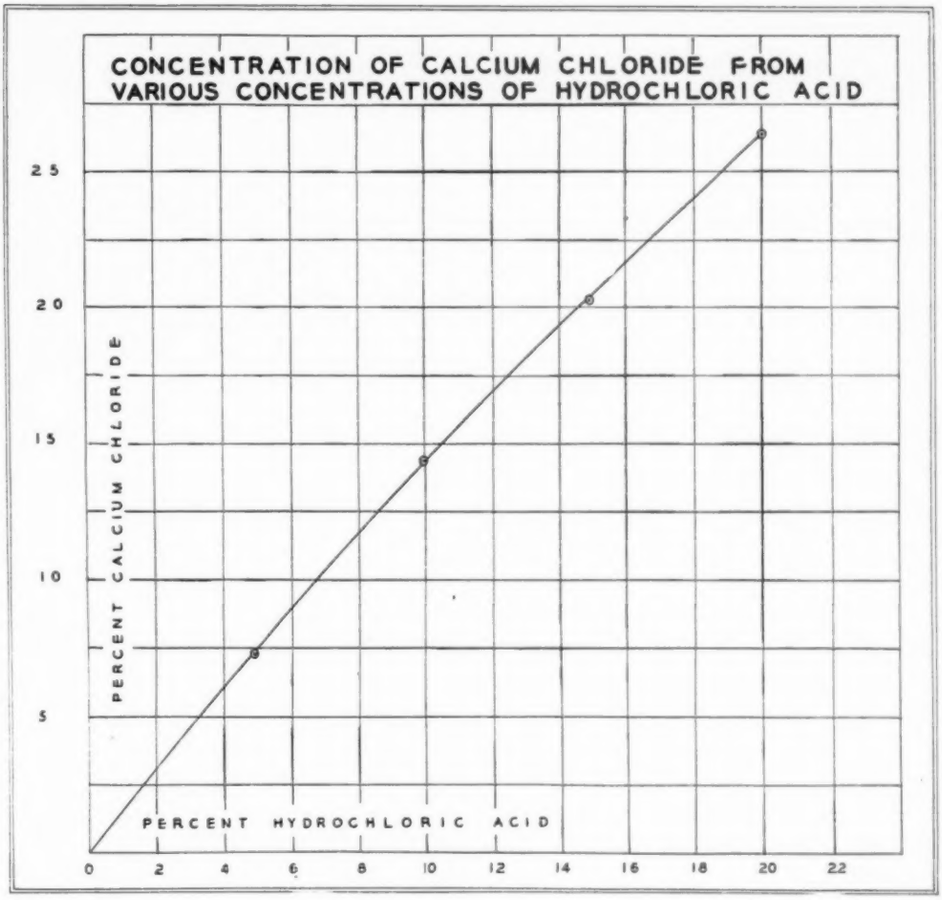
The testing of inhibited acid is carried out under laboratory conditions with an excess of acid on a relatively small piece of steel at the maximum temperature that will be encountered.

New discoveries have made possible an acid fifty times as active as hydrochloric acid and an inhibitor which will reduce its corrosive action on steel to one/two hundredths of the normal. This new excessively corrosive composition is for use where it is desired to remove metal obstructions from wells. Two inhibitors have also been found which substantially prevent the corrosion of iron by dilute aqua regia (a mixture of nitric and hydrochloric acids). This combination will find specific application on certain types of rock, such as serpentine.

The proper selection of the concentration of the acid to be used was one of the very first problems to be taken up when plans were being made for treating the Pure Oil well, Fox No. 6. The higher the concentration of the acid the less the distance to which this acid can penetrate, and the greater the viscosity of the resulting calcium chloride solution. Fifteen percent was determined as the maximum to be used for penetration of the pores of the pay, while twenty percent concentration is sometimes used in the bore of the well itself. The composition of the formation and the rock pressure largely determine the concentration of the acid that is satisfactory.

These considerations immediately led to efforts to reduce the viscosity and surface tension of the resulting calcium chloride solution by addition of various agents. At first this seemed to be solved by the simple addition of a component which was relatively insoluble in the acid, but affected the surface tension even when used in very small quantities. Further tests, however, showed that other materials were necessary, and these were developed. While this special mixture makes the treatment more expensive, experience has proved that the results warrant the extra expenditure wherever this solution is indicated.

In the case of lime scale ("Gyp") deposited on the sides of tubing and casing, or on the face of the formation it has been found neces-



sary to use an acid which has a tendency to spread out on the surface and cover much larger areas in order to avoid the necessity of filling up the well to the level of the calcareous precipitate. To accomplish this, a foaming agent such as gum arabic, is added to the acid and the material called Dowell XG. It helps to spread the acid going past the deposit, particularly if introduced in small intermittent doses.

Many special materials and accessories were found to direct the flow of acid into selected parts of the earth formation. They are still being developed further for use on the more difficult cases. The first, and possibly the most important of these is a heavy liquid layer introduced into the well to form a blanket on the bottom. The first effort along this line was the use of a mud slurry. Later other materials were tried. But all of these were discarded in favor of a heavy solution which would not introduce any permanently insoluble ingredients to plug up pores covered by the blanket.

A particularly simple, but often very effective, combination has been the use of a heavy liquid layer in which a fresh precipitate of calcium hydroxide has been formed. This enters the larger pores and covers the face of the pay to prevent oil from entering the formation while the well is being filled. Then when the acid reaches the formation the volume of the entire amount in the tubing, often equivalent to the total amount of acid to be used, can drop into the smaller pores of the formation just as rapidly as possible. Larger pores naturally are filled with a deeper deposit of lime, and consequently a longer period of time is required for the acid to penetrate them.

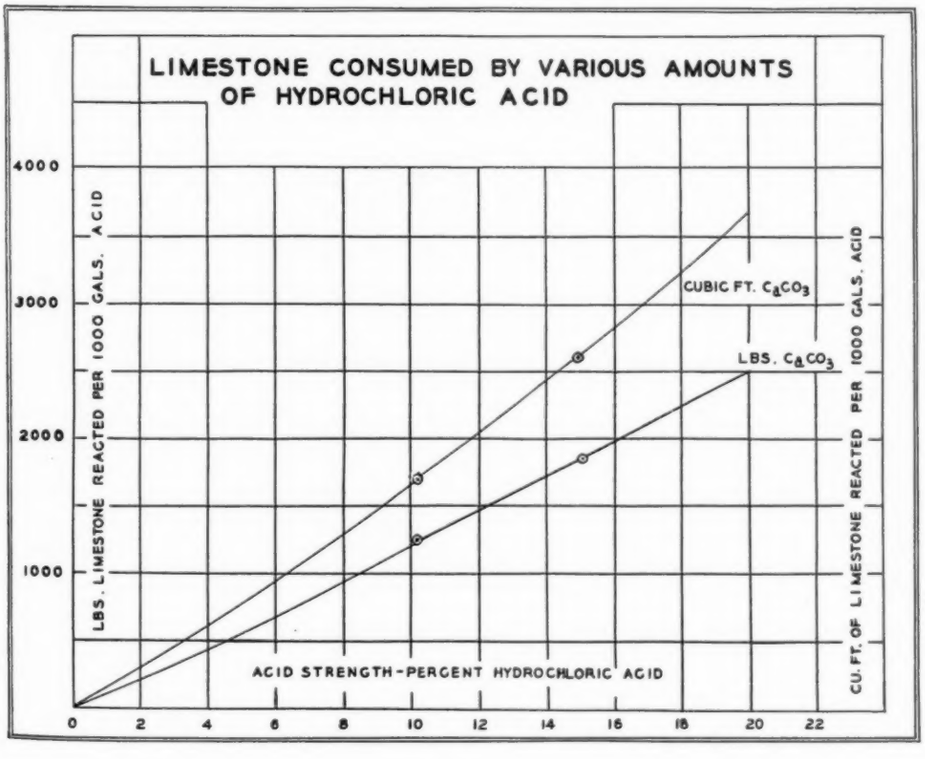
It has often been observed, in the case of such treatments, that the filler supports all the fluid in the hole until a small amount of acid reaches the portion of the pay not blanketed by the heavy solution. The acid then drops out of the tubing into the formation in a very short time. The oil stored in the casing follows the acid into the "pay," and thus pushes it a greater distance from the hole before its reaction is completed. This technique is particularly desirable on relatively depleted wells where distant pores are to be reached by the acid in order to tap new reserves.

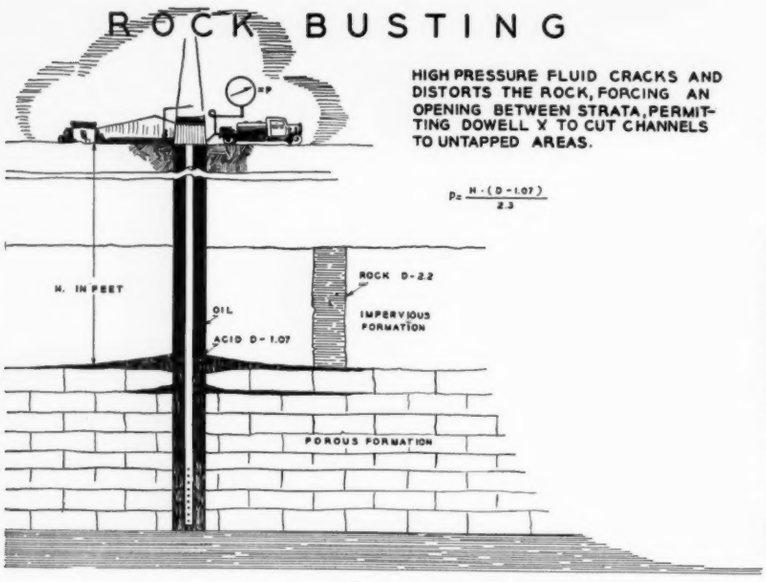
Dowell Plug is a mud of insoluble minerals with soap solution used to protect the bottom of the hole against the action of the acid.

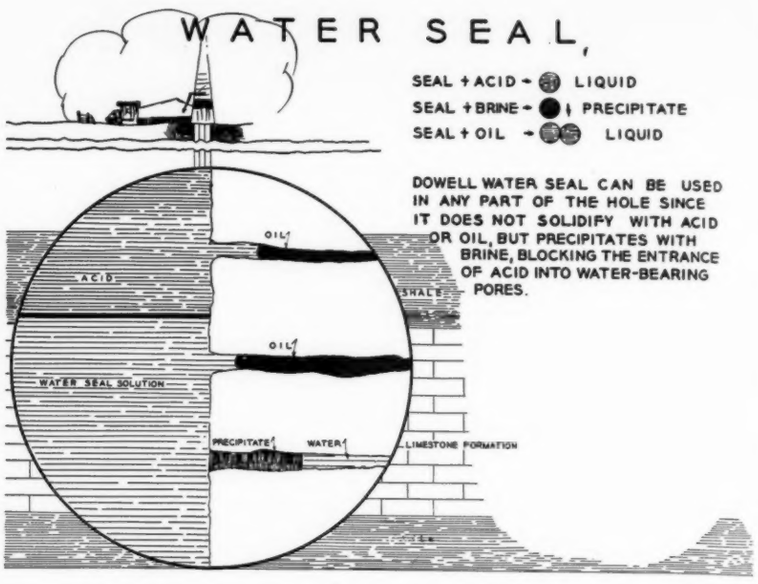
It is well to recognize that the acid cannot eat out large pockets at the bottom of the well, since it consumes only ten percent of its volume of limestone. This is a particularly advantageous property, because it forces the acid to increase the size of pores as it passes through, rather than wasting its strength on the face of the well. Rock samples shot out of a well after treatment show the original tool marks left intact, while the acid has enlarged certain pores to the size of a pencil lead, giving the appearance of a worm-eaten wood.

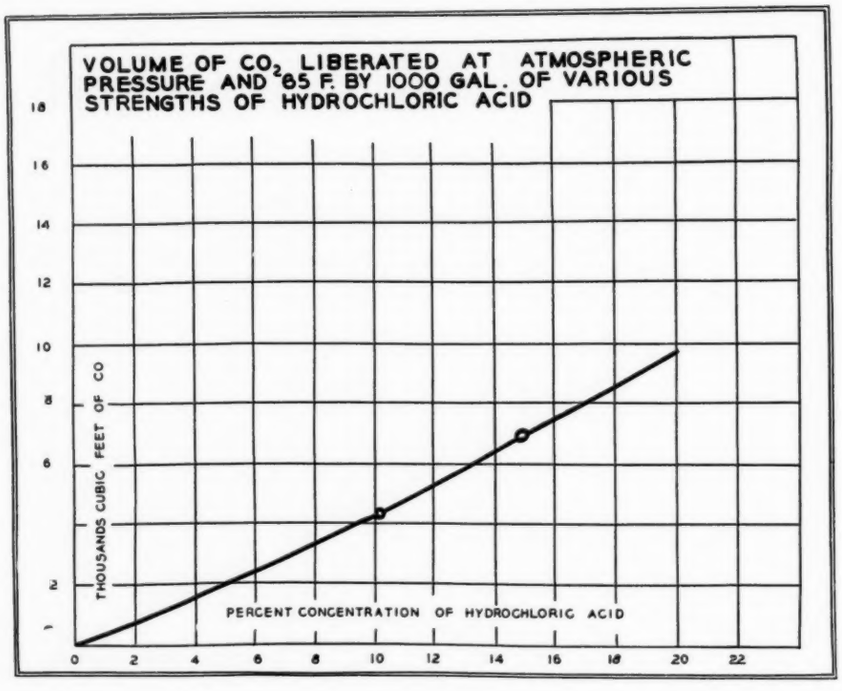
Early in the development of its service Dowell began looking for a material which would have the unique property of becoming viscous, or solid, when coming in contact with brine or pores wetted with brine; but remaining liquid as long as it is in contact with oil, acid, paraffin solvent, or other agents used in the treatment of a well. This apparent conundrum was answered by nothing more simple than a soap of a certain type. This material makes a water seal that effectively prevents acid from following those pores which lead to water, and forces it into the oil pores. This material, called Water Seal, when properly used, helps very considerably to reduce the brine or water accompanying the usual increase in oil production. In some instances water has been shut off for long periods of time, suggesting that water seal might be used for sealing off water, independently from acid treatments.

Filler "B," is another material of very specific properties. The problem was to develop a material to enter the well as a liquid; and, when in place, to solidify like glue or cement so that a well could be plugged to a definite level that could be measured by lowering a line. After a predetermined time this artificial plug was to disintegrate and liquefy so that it could




ROCK BUSTING
HIGH PRESSURE FLUID CRACKS AND DISTORTS THE ROCK, FORCING AN OPENING BETWEEN STRATA, PERMITTING DOWELL Y TO CUT CHANNELS TO UNTAPPED AREAS.
$P = \frac{H \cdot (D - 1.07)}{2.3}$
H. IN FEET
OIL
ACID D - 1.07
ROCK D - 2.2
IMPERVIOUS FORMATION
POROUS FORMATION


WATER SEAL
SEAL + ACID → LIQUID
SEAL + BRINE → PRECIPITATE
SEAL + OIL → LIQUID
DOWELL WATER SEAL CAN BE USED IN ANY PART OF THE HOLE SINCE IT DOES NOT SOLIDIFY WITH ACID OR OIL, BUT PRECIPITATES WITH BRINE, BLOCKING THE ENTRANCE OF ACID INTO WATER-BEARING PORES.
OIL
ACID
SHALE
OIL
WATER SEAL SOLUTION
PRECIPITATE
WATER
LIMESTONE FORMATION


VOLUME OF CO_2 LIBERATED AT ATMOSPHERIC PRESSURE AND 65 F. BY 1000 GAL. OF VARIOUS STRENGTHS OF HYDROCHLORIC ACID
THOUSANDS CUBIC FEET OF CO
PERCENT CONCENTRATION OF HYDROCHLORIC ACID
18
16
14
12
10
8
6
2
0 2 4 6 8 10 12 14 16 18 20 22

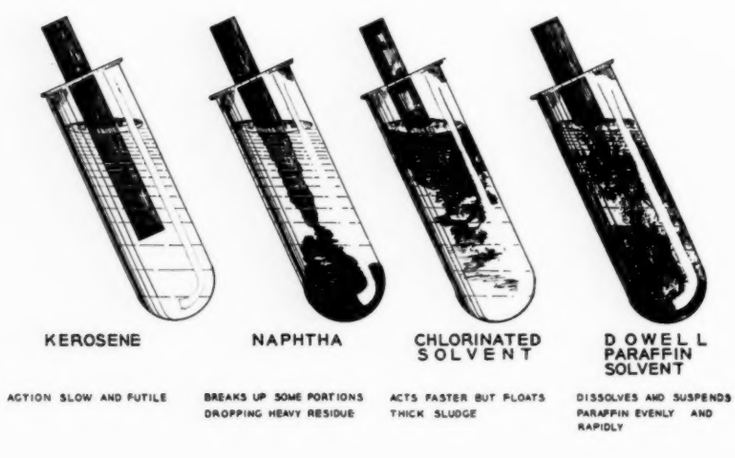
be pumped out and leave the well with no permanently closed pores such as would be the case if it remained solid. The answer to this was found in an organic jellyfying material which gradually swells and solidifies even under the higher temperatures at the bottom of the hole. Later the action of bacteria growing in this medium converts the gel to fluid products even if covered by oil.

A study of directive agents for the control of the acid entering the pores of the rock must include a consideration of paraffin accumulation that may be present. In some instances it is undesirable to touch the paraffin at the bottom of the well prior to acid treatment, while in others it is very essential to remove it from the bottom portions of the pay so that the acid is not forced into the upper more depleted areas where it will merely serve to increase the gas production with only a slight increase in oil production.

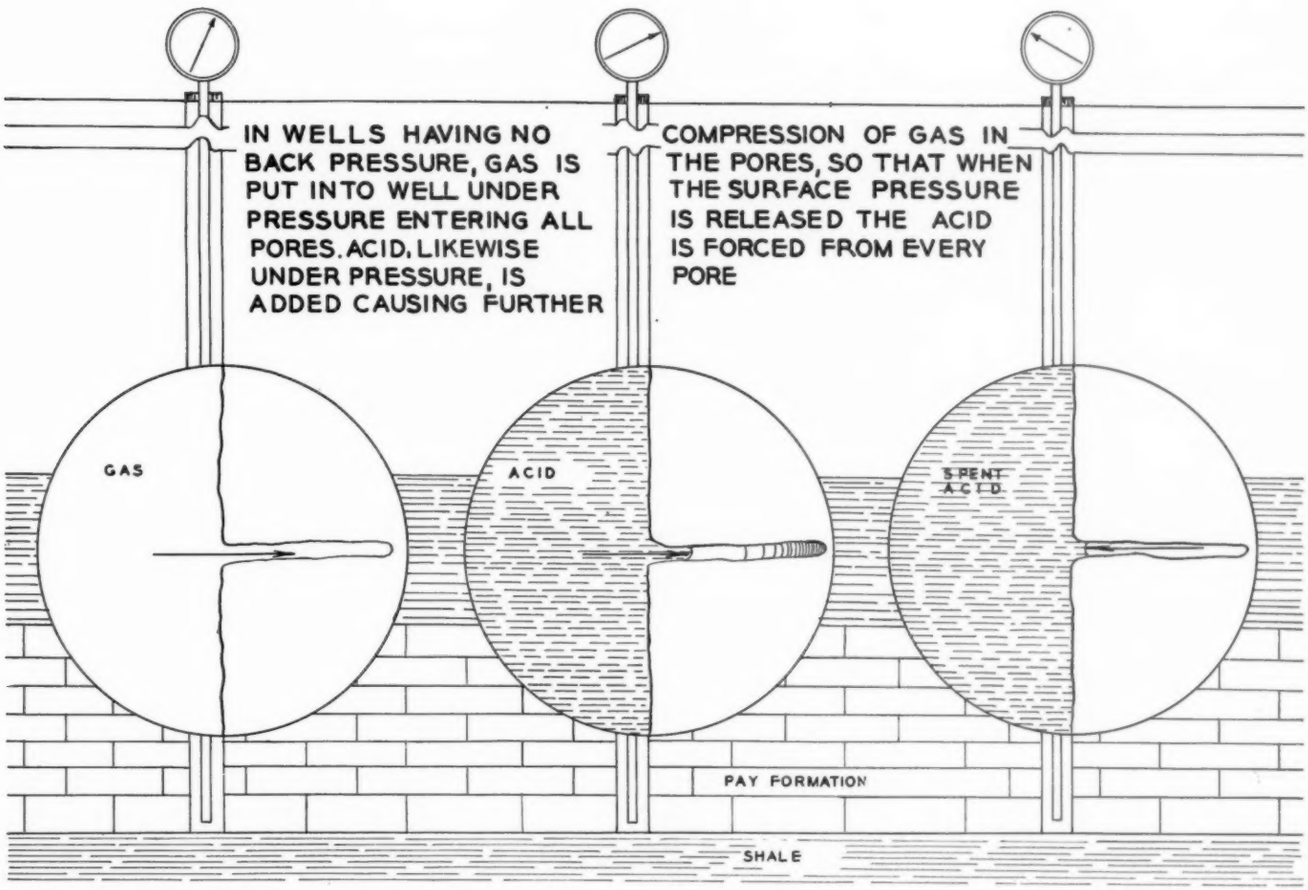
Considerable work has been done by our research laboratories to make the best paraffin solvent possible available to the industry.

It was observed that casing-head gasoline and naphtha are very good solvents for certain constituents of paraffin, particularly if they are not permitted to re-evaporate and thus allow the paraffin to be reprecipitated. Because average specific gravity of paraffin is considerably higher than that of naphtha, residues of less soluble portions remain behind and are then even more difficult to remove than before.

Among the possible other agents certain chlorinated derivatives were also found to be good solvents for some of the ingredients of paraffin. In this case, however, the tendency of the insoluble portion is to float, causing sticking and gumming where it is not desired. It was found then that the proper combination of naphtha and these chlorinated solvents, so as to obtain a specific gravity approximately equal to that of the paraffin, made it possible for the combined solvent action to dissolve a greater portion than either one alone, and yet not leave any residue behind, because it is retained in a suspension. The combined sol-



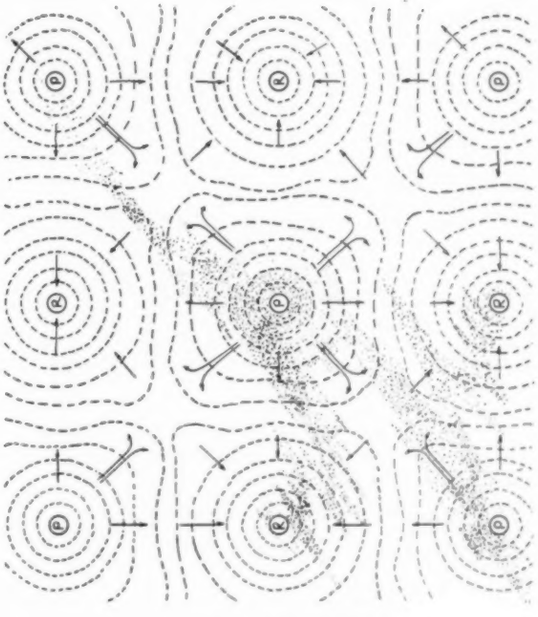
GAS REPRESSURING


IN WELLS HAVING NO BACK PRESSURE, GAS IS PUT INTO WELL UNDER PRESSURE ENTERING ALL PORES. ACID, LIKEWISE UNDER PRESSURE, IS ADDED CAUSING FURTHER
COMPRESSION OF GAS IN THE PORES, SO THAT WHEN THE SURFACE PRESSURE IS RELEASED THE ACID IS FORCED FROM EVERY PORE
GAS
ACID
SPENT ACID
PAY FORMATION
SHALE

vent is about equal in solvent ability to heated naphtha, in addition to having the proper specific gravity. The correct method for applying and using this solvent is easily determined, since it is the equivalent of naphtha that is kept hot all through the treatment, which, when pumped through the tubing will soften and suspend the paraffin accumulation and carry it to the surface. For bottom hole work the processes, as covered by the Hoon and Wolever patents, may be used. These patents cover the use of heat and agitation and a solvent of sufficiently high specific gravity to be active in the bottom of the hole. Dowell paraffin solvent base when properly mixed with light naphtha or casing-head gasoline serves these purposes perfectly.

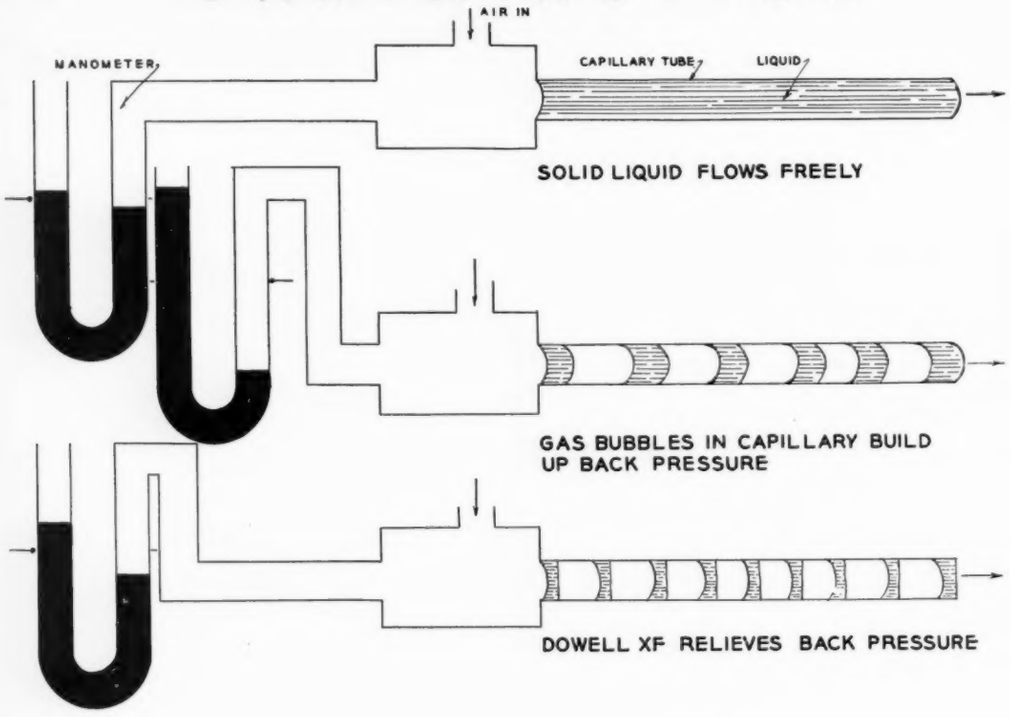
It is most fortunate that in a treatment of lime rock carbon dioxide (CO_2) is evolved in the gaseous form whenever the pressure is low enough to keep it from dissolving in the resulting calcium chloride solution or the oil. This property has made possible the effective treatment of many wells, though with improper technique it can be a serious detriment. The accompanying graph (p. 478) gives the amount of CO_2 gas produced, measured at atmospheric pressure, for various strengths of hydrochloric acid and per 1,000-gallon treatments.

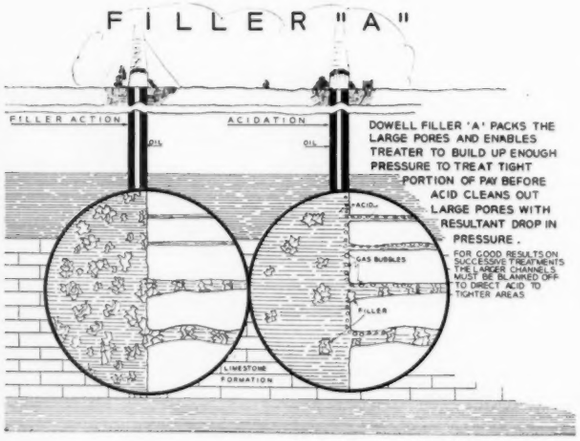
GROUP WELL TREATMENT

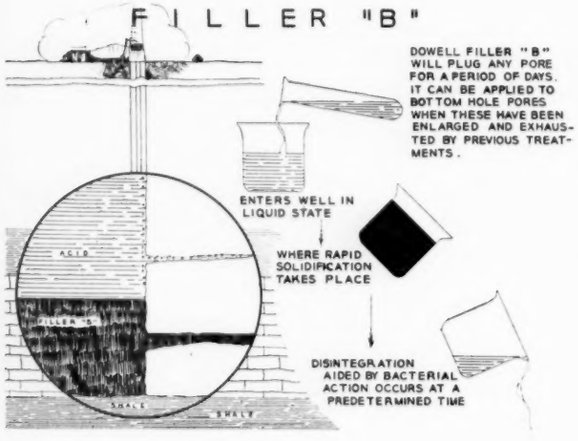


PRESSURE CONTOURS IN EARTH OF WELLS (P) FORCING OIL FROM UNDRAINED AREAS TO RECEIVER WELLS (R) AFTER DEPLETED AREAS ARE BLOCKED OFF BY JAMIN ACTION.

JAMIN ACTION




FILLER "A"
FILLER ACTION
ACIDATION
OIL
OIL
DOWELL FILLER 'A' PACKS THE LARGE PORES AND ENABLES TREATER TO BUILD UP ENOUGH PRESSURE TO TREAT TIGHT PORTION OF PAY BEFORE ACID CLEANS OUT LARGE PORES WITH RESULTANT DROP IN PRESSURE.
FOR GOOD RESULTS ON SUCCESSIVE TREATMENTS THE LARGER CHANNELS MUST BE BLANKED OFF TO DIRECT ACID TO TIGHTER AREAS
ACID
GAS BUBBLES
FILLER
LIMESTONE FORMATION


FILLER "B"
DOWELL FILLER "B" WILL PLUG ANY PORE FOR A PERIOD OF DAYS. IT CAN BE APPLIED TO BOTTOM HOLE PORES WHEN THESE HAVE BEEN ENLARGED AND EXHAUSTED BY PREVIOUS TREATMENTS.
ENTERS WELL IN LIQUID STATE
WHERE RAPID SOLIDIFICATION TAKES PLACE
ACID
FILLER "B"
DISINTEGRATION AIDED BY BACTERIAL ACTION OCCURS AT A PREDETERMINED TIME
SHALE
SHALE

Whenever one encounters gas and liquid in small pores it is necessary to consider the resistance to flow produced, which is not subject to the normal laws of viscous flow. This is due to the interfacial-tension effect of alternate gas and liquid surfaces in the pores of capillary dimensions. For example a capillary tube filled with liquid can easily be drained with slight differential pressure. A capillary tube filled with gas is still more easily discharged. But such a tube filled with alternate slugs of gas and liquid will resist flow, the same way a small capillary holds on to and retains water. By the time this small force for each liquid-gas boundary is multiplied many thousands of times it becomes quite appreciable, so that hundreds of pounds of pressure can be held in check by the combined action of the small bubbles. This phenomenon is called Jamin Action after its discoverer. It is treated thoroughly in a book by Herold.

Many of the odd experiences reported as unique, such as wells that refuse to produce for several hours, days, or months after treatment and then suddenly start flowing again, are explained by this action. Many peculiar effects in connection with acid treatments, such as the rise of back pressure in very soluble rock when it is known that the rock has been made more porous by the first acid going in, are equally clear in view of this phenomenon. All these effects should be thoroughly understood and made use of in the subsequent treatments of such wells or other wells of similar type. This emphasizes the value of the practice on the part of Dowell to keep complete records of all treatments.

Very often it is possible to take advantage of this Jamin Action to choke the flow of acid into old depleted pores and force the acid into new areas with higher rock pressure. In some areas, particularly those in which the first acidation was not properly controlled and the charge was merely dumped into the well, it is quite necessary for retreatments to build up an effective Jamin Choke to control the flow of acid by the introduction of large quantities of gas with smaller quantities of a liquid with high surface tension.

To increase the effectiveness of the Jamin Choke, gas is introduced with acid containing a foaming agent, or better yet with a viscous high gravity solution, such as Dowell Blanket, to plug up the larger pores leading to depleted areas. Retreatment of wells which otherwise would have been quite fruitless has become of commercial value by the use of this combination.

By far the most important application of the Jamin Choke will be in the treatment of groups of wells in order to obtain the maximum recovery from a given field. Wells, which as the result of a previous acid treatment, or simply because of the irregularities of the limestone formation, do not lend themselves to repressuring and other forced drives, can be plugged off so as to prevent the by-passing of the repressuring agents through relatively open pores, thus applying the driving force behind the remaining oil-filled rock.

In old fields where the rock pressure is low even free flowing acid is not, at times, as effective as it should be, since it is hard to remove the products of the reaction from the pores after the acid has been forced into them under high pressure. By repressuring the formations adjacent to the well with gas before the acid treatment and carefully watching the bottom hole pressure after the introduction of the acid, it is possible to blow off the well at the time when the maximum amount of pressure energy is stored in the surrounding pores and the acid is practically spent. The carbon dioxide gas produced with or without the help of natural gas introduced before the acid, blows the products of the reaction into the bore, sometimes with sufficient force to make the well flow for a short time.

If the time of blowing off is not properly controlled by having an accurate reading of bottom hole pressures, as is made possible by filling the tubing with gas after the treatment, the energy is spent in forcing the calcium chloride solution with the residual mud and gas further into the pores. This creates a plugged-up condition, especially where the rock pressure is low, which in some instances has required months to remove. The case of a well being plugged off for several hours or days after being opened for production is much more common. Such occurrences, however, are avoided by the proper control in blowing off the well, aided by gas repressuring when possible.

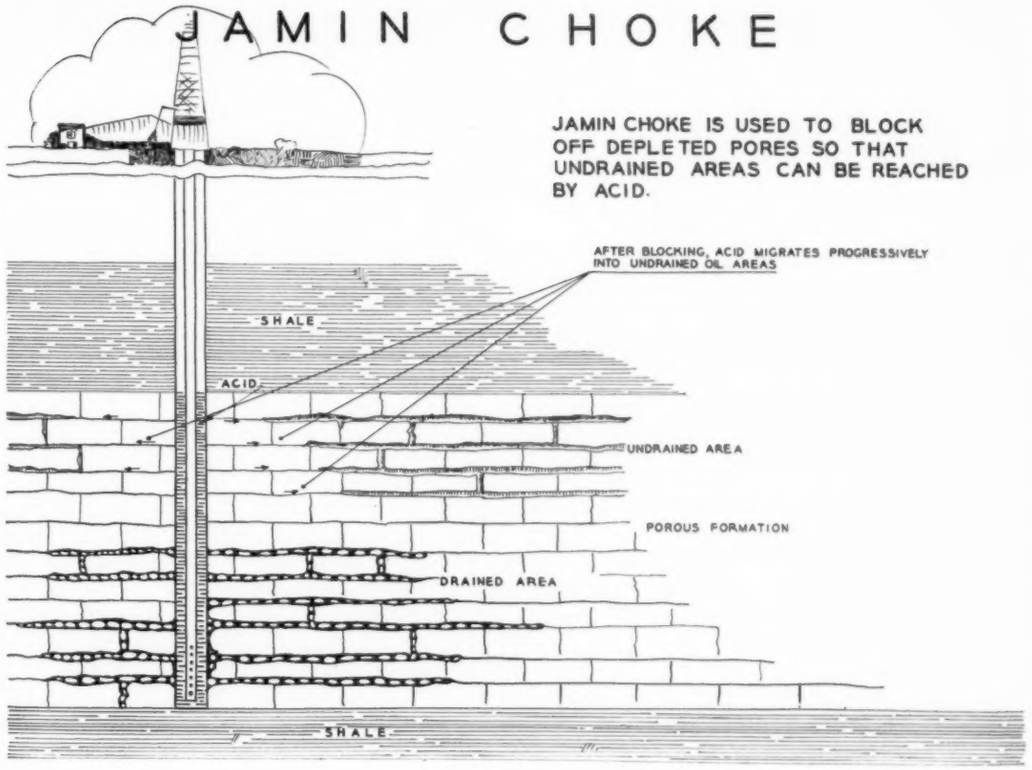
Very often it is not realized that a sandstone formation with an acid soluble cementing material can be acidized effectively although the remarkable results often obtained in lime formations are not to be expected in the more uniform structure of sandstones. The first time a well of this type was treated it was

recognized that the concentration of the acid must be low enough so that the porosity of the rock could be increased by the removal of only a portion of the binder of the pay entered by the acid. Otherwise a strong acid solution would have to be pumped out of the well and in addition the sand would cave in continuously causing serious cutting of pumps and valves. A five percent solution was decided on as a precaution. Actually what happened was that the production was increased very considerably at first, but the well was abandoned after several months of futile effort because the sand never stopped caving in. A much more dilute solution is recommended for such cases. The field of application of such treatments should become much larger than is realized at present.

In the experiments on treating wells with acid for the production and disposal of brine for the Dow Chemical Company it was discovered that a fluid pressure at the bottom of the well sufficient to counterbalance the weight of the rock above it plus an additional pressure required for actually breaking (cracking) the formation, makes possible the introduction of fluids into new crevices thus created. Many wells have been treated effectively in this way. High pressure hydraulic acid pumps were developed very early. These are capable of producing sufficient pressure to force acid into newly made cracks, while the earth is compressed and even lifted. Wells are often completed dry, but by application of acid under high pressure pores are developed which lead to reservoirs and more porous portions of the formation. In fact one of the main factors in the increase of production made possible by acid treatments is the production from wells which penetrated tight zones in oil bearing formations and would have been dry if not acidized. In addition to this it has been recommended quite frequently that wells of this nature be given a shot with an explosive before acidizing in an attempt to crack the formation, particularly when the depth of the pay is such that it would be quite out of the question to obtain sufficient pressure to distort the earth.

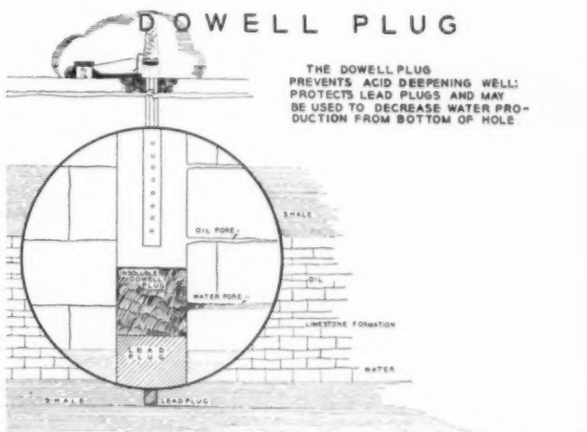
While trying to fill a well with oil in order to control the depth at which the acid is to penetrate the rock, it is often observed that a well will not fill due to extreme porosity. In order to learn this as soon as possible and to avoid the introduction of an unnecessary amount of dead oil into the pores of the pay it is very advantageous to connect a gas meter or a flow meter to the casing so as to measure the rate of flow of gas out of the well in relation to the amount of oil entering the well. When it is found that the oil flows into the pay formation at a rate which prevents the filling of the well, further introduction of oil is stopped and other treating methods are employed.

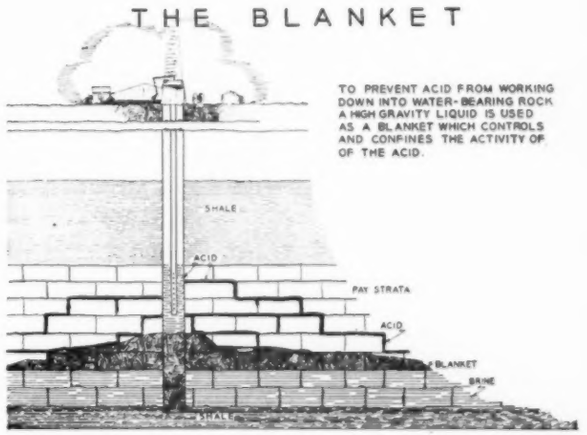
Many possibilities for improving the results are dependent upon the proper diagnosis of treatment from information concerning the condition of the well and from statistical data on related treatments. By maintaining thoroughly indexed records and by tabulating treatments under similar conditions, acidizing is being directed toward rational standard procedures.

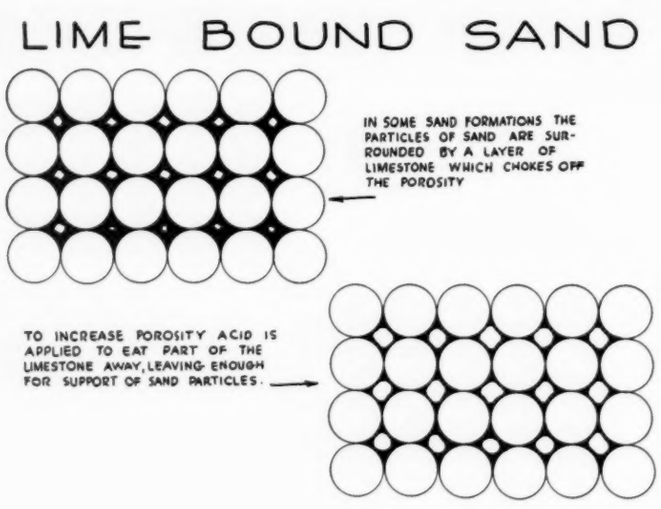

JAMIN CHOKE
JAMIN CHOKE IS USED TO BLOCK OFF DEPLETED PORES SO THAT UNDRAINED AREAS CAN BE REACHED BY ACID.
AFTER BLOCKING, ACID MIGRATES PROGRESSIVELY INTO UNDRAINED OIL AREAS
SHALE
ACID
UNDRAINED AREA
POROUS FORMATION
DRAINED AREA
SHALE

A generalized picture of the possibilities of the acid treating methods described in this article is given in illustration, p. 476. An oil bearing lime formation is shown penetrated by nine wells. The grain of the continuous porosity of the rock is spotty and irregular as shown, but oil is also held throughout the body of the rock in pores not freely connected with another. The density of the color shows the amount of recoverable oil in any area. Ordinary methods of production find that some of these wells are dry holes, others very small producers, and still others very large producers with a short life. The decrease in the density of the color surrounding the wells shows the area drained and the degree of recovery of the oil. Finally repressuring and flooding is used to recover possibly 35 percent of the total oil in the reservoir. The proper acid treatment makes possible the more complete drainage of the oil under its own natural head by increasing the porosity around the drilled hole and the channels. These enlarged crevices drain the more porous sections as well as getting a more uniform recovery from the various levels of the pay formation. Proper retention of gas pressure behind the oil and the larger rate of production greatly aid a large ultimate recovery. Some geologists have placed the recovery with proper acidization at 25 percent above the usual 25 to 35 percent of the total oil in the reservoir recoverable by usual practices.

By the proper treatment of the wells in groups so as to connect them as desired it is possible to drain the formation much more completely and in addition to apply the driving medium along a line or horizontal channel instead of only in the bore hole, thus reducing




THE BLANKET
TO PREVENT ACID FROM WORKING DOWN INTO WATER-BEARING ROCK A HIGH GRAVITY LIQUID IS USED AS A BLANKET WHICH CONTROLS AND CONFINES THE ACTIVITY OF OF THE ACID.
SHALE
ACID
PAY STRATA
ACID
BLANKET
BRINE
SHALE


LIME BOUND SAND
IN SOME SAND FORMATIONS THE PARTICLES OF SAND ARE SURROUNDED BY A LAYER OF LIMESTONE WHICH CHOKES OFF THE POROSITY
TO INCREASE POROSITY ACID IS APPLIED TO EAT PART OF THE LIMESTONE AWAY, LEAVING ENOUGH FOR SUPPORT OF SAND PARTICLES.

the number and the size of the lenses of oil to which it is difficult to apply a driving pressure to keep the oil flowing into the receiver wells. This, combined with Jamin Choke to prevent the short circuiting of repressuring agents may make an ultimate recovery of 65 percent possible without going to prohibitively high costs of production.

It may seem foolish to some people to talk about many variations and combinations of materials for acidizing a well, but these developments are as essential as the various types of drilling methods, tools, and procedures. No one would expect that one tool used one way would serve all the requirements of well drilling under all conditions, depths, and formations. The number of modifications that are to be expected and the refinement of equipment required for this, will increase instead of diminish. Many of these are even now in a state of development and awaiting further patent protection before they are discussed. The practice of simply "dumping" a shot of ordinary acid into a well followed by some oil, is rapidly going into discard. Anyone giving the subject a little thought will realize that any powerful agent can be misapplied, as well as used to the great advantage of the oil industry.

The extensive development work described in this article has required the efforts of a large number of research workers. We wish to make special acknowledgment of the help of the following: Ray H. Boundy, Leonard C. Chamberlain, J. Lawrence Amos, John G. Staudt, and William Fry.—Author

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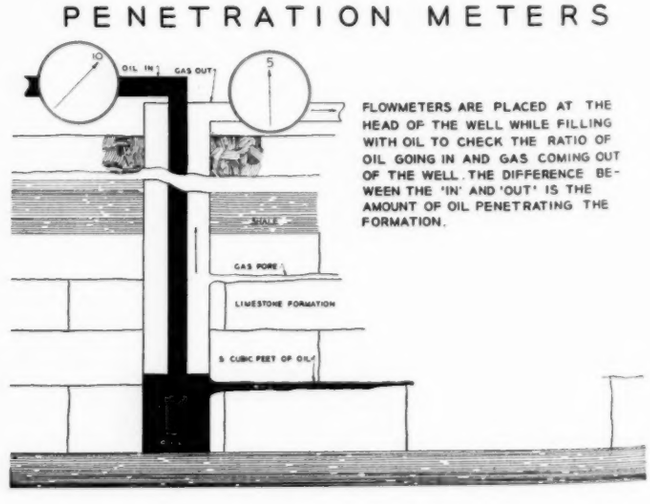

PENETRATION METERS
10
OIL IN
GAS OUT
5
FLOWMETERS ARE PLACED AT THE HEAD OF THE WELL WHILE FILLING WITH OIL TO CHECK THE RATIO OF OIL GOING IN AND GAS COMING OUT OF THE WELL. THE DIFFERENCE BETWEEN THE 'IN' AND 'OUT' IS THE AMOUNT OF OIL PENETRATING THE FORMATION.
SHALE
GAS PORE
LIMESTONE FORMATION
5 CUBIC FEET OF OIL

Cole Committee to Report

(Continued from page 458)

tute's Board of Directors preparing to take up in New York early in August a proposed draft of a marketing code to replace the NRA code, which would be submitted to the Federal Trade Commission after being approved by the Board and then gone over by the industry at large.

While the members of the drafting group, under the leadership of C. E. Arnott of Socony-Vacuum, have made vigorous efforts to keep the light of publicity off their efforts, authentic sources divulge that the draft, in so far as it goes, follows the principles of the NRA code rules covering equipment, loans, repairs, price posting and credit terms.

It avoids a declaration on the controversial lease and agency question and ignores cooperatives. Some 17 rules are provided for, with the present plan to offer them as revisions to the 1931 trade practice rules approved by the Federal Trade Commission.

Whether a hearing will be called by the Trade Commission is an undetermined question. Indications point to an effort to obtain approval without a hearing, since the proponents of the code intend to present it to most of the industry through contacting various associations and regional groups.

July saw the passing of the Planning and Coordination Committee, which wound up its activities as of July 21 and officially ceased its existence. Although advised by Administrator Ickes that, under the continued NRA, he would need an advisory council, the consensus of members, in letters to Chairman J. D. Collett, was that the Planning and Coordination Committee should be discontinued.

A successor committee, with a new name and such duties as might be authorized, could be set up, members felt, if it were held to be necessary that the industry have a spokesman in Washington. Secretary Ickes, asked what he intended to do about it, said he would await the outcome of legislation before establishing a successor.

Four other developments of interest went forward as the month closed, three legislative and one administrative. The latter was a ruling by Comptroller General McCarl that Administrator Ickes' prohibition against receipt of bids from the Texas and Continental Companies, charged with violation of labor provisions of the code, was no longer in effect. An amusing angle was that the ruling came on bids to supply the Bureau of Reclamation in Ickes' Department of the Interior.

The Senate Public Lands Committee reported out a revised mineral leasing act bill, advocated by Senator O'Mahoney (D-Wyo.) and applicable to the petroleum and gas sections of the laws of 1920. The most important points were the substitution of a sliding scale of royalties, and a requirement that the Department of the Interior issue permits to applicants whose applications have been on file 90 days or more when the bill becomes a law.

The tax program of the Administration moved along in a welter of conflicting rumors over whether passage would or would not be insisted upon before Congress can go home. Since the President has said that those with a weak case want to delay action, in referring to opponents, it would appear that he can not, with good grace, back up from previous insistence that it be passed immediately.

No action of consequence came on the Walsh Labor Standards bill, which is the real successor to NRA and which would require observance of strict wage and hour schedules by any company supplying any goods paid for in any manner with government funds, including expenditure of relief grants, public works and Reconstruction Finance loans, and the other Washington moneys.

Statisticians in various governmental and trade association units have figured out that this expenditure would probably apply to about 10 percent of the trade volume of the country in daily circulation and would give the government a powerful lever with which to insist upon fair pay and hours.

▼

Death of Judge Ames

CHARLES B. AMES, chairman of the board of The Texas Corporation, died suddenly July 21 at his summer home in Meredith, N. H. His death was entirely unexpected and was due to a heart attack as he was returning to his house following a swim. News of his passing came as a great shock to his business associates and his host of friends in the industry.

Judge Ames was born in Macon, Miss., in 1870. He received his collegiate training at Emory and Henry College and his law degree from the University of Mississippi. After a few years spent in local practice, and following his marriage in 1894 to Miss Elizabeth Allen of Macon, he removed to Oklahoma City where he entered upon a distinguished legal career which included service as a judge of the Supreme Court of the state, president of the state bar association and Assistant United States Attorney General under the Wilson administration.

His connection with the oil industry was a natural outgrowth of his law practice in Oklahoma. He first served The Texas Corporation in a local capacity and subsequently became general counsel, being elected a vice president and director in 1928. He resigned this position in November 1932 to accept the presidency of the American Petroleum Institute but returned to The Texas Corporation a few months later as chairman of the board, a position in which he served up to the time of his death.

Few men in the oil industry have had a wider or more devoted circle of friends.

▼

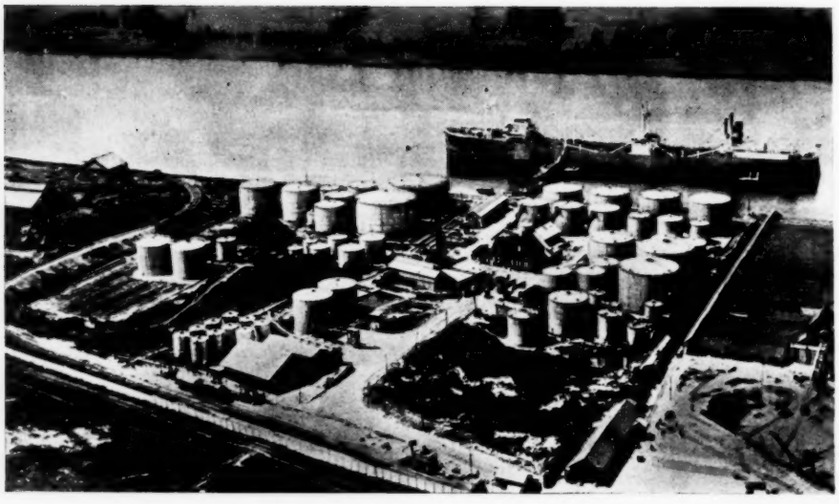
French Refiners Deny Sale to S. O. Cal.

IN AN ARTICLE published in June WORLD PETROLEUM on the expansion of the international activities of Standard Oil Company of California reference was made to the reports current in European oil circles at the time that negotiations were under way for the acquisition of part ownership in the Raffinerie de Berre and Raffinerie du Nord by the California company.

The article was correct in stating that such rumors were in circulation but we are now informed by the two refineries mentioned that there is no substantial basis for these reports, that no such negotiations have been conducted with California Standard and that their relations with the company have been confined to purchases from it of Kettleman crude.

Meanwhile the operations of Standard of California continue to occupy a widening range in other parts of the world. In British Columbia the company has broken ground for a new refinery and has purchased a group of service stations in that territory.

In eastern Saudi Arabia the company's first well is down over 1,000 feet.



Independent Storage Facilities at Antwerp

ONE OF the interesting oil terminals of Europe is that of Antwerp Oil Wharves located at Hemixem, Belgium, a few miles up river from the city of Antwerp. The plant was erected by British interests to provide bulk storage for independent importers and was opened for business in 1930. It has since been expanded and fourteen additional tanks were erected recently bringing the total storage capacity up to 60,000 cubic metres. In addition to the 76 storage tanks there are a number of smaller filling and blending tanks.

Mooring and transfer facilities are designed for the prompt loading or discharge of cargoes. Vessels up to 540 ft. length and 33 ft. 9 in. draught can be handled at the wharf the channel being wide enough so that all ordinary tankers can swing directly opposite the terminal.

A floating pier, 50 yards long, supported by two pontoons carries the pipelines from ship to shore, connections being made by means of flexible hose. The pontoons are round-bottomed in order that the strain imposed upon them by ice packs and the frequent tidal bores shall be diminished, the force tending to lift rather than to over-turn. The wharf is efficiently flood-lighted for night operations and vessels may be bunkered, either from lighters along side or from shore tanks, day and night. Communication from pump-house to ship is facilitated by means of a special telephone line between the two points.

Loading is effected at 200 to 300 tons per hour according to the product being handled. Tankers discharge into shore tanks using their own pumps but shore assistance in the form of steam and portable pumps is available when necessary.

The river wall is now being considerably enlarged. This will enable more barges or small river tankers to be loaded or discharged simultaneously with the discharge of an ocean-going ship, the smaller boats being arranged along the concrete jetty on both sides of the landing stage. A number of barges or small tankers can be dealt with at the same time as a large ocean vessel in consequence of the quick rate of pumping already mentioned. Delays are therefore practically non-existent.

The wharf was designed with a view to prevention of contamination of the products stored and the same principle has been carried out in the additions which have been made. Separate pumps and pipelines are reserved for the various classes of oil, and all storage tanks are first cleaned by steam, followed by sand-blasting, thus removing even the most sticky oil.

The installation has 22 steam-driven duplex piston pumps of various makes. Pumping distances are short and the back pressure, including line friction, is very low. The five miles of pipe are mostly six inch, although there are also some eight and ten inch lines for certain products.

The plant is thoroughly equipped for the filling of road cars, rail cars and steel drums. The dispatch of road cars has been mostly for the local disposal of products. Rail cars go to many different countries such as France, Holland, Switzerland and Italy. Transit by tank barge down the Rhine is largely used from this depot.

The blending plant is modern and many importers take advantage of this by bringing in the basic products and blending them as required in accordance with the current demands.

Blending of lubricating oils is carried out by carefully measuring the requisite quantities of which the blend is to be composed into small horizontal tanks. Heat is then applied and the homogeneity of the mixture is ensured by compressed air being blown through the oil and not by the use of paddles. This has been found in practice to give the best blending. Here again two or three devices thought out by the staff have materially assisted the process.

The barrelling plant has a turn-over of 250 tons, about 1,400 drums, per day.

Dutiable products which are stored in the installation can be stored in transit, and payment of duty is unnecessary if they are being dispatched outside Belgium. Insurance rates are extremely low.

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New High-Yield Casing

THE A. O. SMITH CORPORATION of Milwaukee is bringing out a new type of casing which is the result of long continued research and tests. Its particular advantage is an extremely high yield point, making it possible to resist extremely heavy pressures. In view of this special quality the trade name "High-Yield" has been adopted for the product.

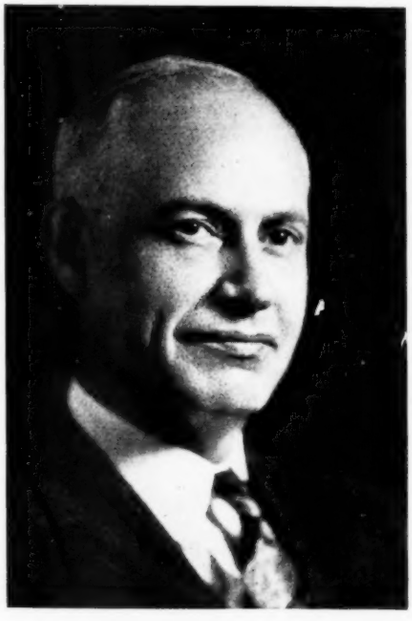
The process by which the casing is made is patented and is said to represent a departure in this type of metal working. The metal is cold worked during manufacture and the compression yield strength has been raised to very nearly the ultimate tensile strength of the steel.

Advantages claimed for the new casing in field use are that lighter strings may be run with no sacrifice in resisting strength and that drillers will be able to go to greater depths with larger sizes than heretofore. The casing is made to API standard dimensions and production has begun in $6\frac{5}{8}$" and larger sizes.

The A. O. Smith Corporation also announces that it is establishing a branch office at Houston, Texas, in addition to the branches now maintained in New York, Tulsa and Los Angeles.

Foreign Oil Legion

W. R. MOOK, vice-president and director of the Standard Oil Export Corporation, whose election to the presidency of Standard Oil Export Corporation was mentioned in the July issue of WORLD PETROLEUM, joined the Standard Oil Company in 1898 as a clerk in the office of the Pratt Works at 26 Broadway. In 1903 he became invoice clerk in the newly



W. R. Mook

organized Export Sales Department under the management of F. D. Asche. In 1911, at the time of the dissolution, he was placed in charge of the Sales Division of the Foreign Sales Department. In 1918 Mr. Mook was transferred from the Sales Division to the Marketing Division of the Foreign Sales Department and became assistant to Mr. D. L. Harper.

The Standard Oil Export Corporation was formed in 1928 with Mr. D. L. Harper as President and Mr. Mook as Vice-President and Director. Mr. Mook was born in Metuchen, New Jersey and still resides there.

MICHEL CONSTANTINESCU, vice-president Creditial Minier, S. A., has been visiting England on a two weeks' vacation.

NUBAR GULBENKIAN, director of the Iraq Petroleum Company had a remarkable escape from death on July 17 when a plane in which he and seven other people were travelling from Heston to Spithead for the fleet review, crashed and caught fire. Two of the passengers were killed and the others, including Mr. Gulbenkian, were badly, but not fatally, burned.

WILLIAM F. MOORE, well known as vice-president and general manager of Process Management and Gasoline Products Companies, was elected president of these two companies at the last meeting of the board.

DR. J. A. L. HENDERSON, vice-chairman of the New Brunswick Gas and Oil-Fields, Ltd., left England on the EMPRESS OF BRITAIN for a business trip to the United States and Canada. He may be located during his visit through the Moncton, N. B., offices of the company.

W. D. CROMPTON of Paris, director of Standard Franco-Americaine de Raffinage, made a brief business trip to the United States at the beginning of July.

PHILIP H. PATCHIN, assistant to the president of the Standard Oil Company of California was elected a member of the Board of Directors July 26th. Mr. Patchin, in early life, was a correspondent for the Associated Press. In 1909 he was appointed chief of the division of foreign intelligence of the State Department, which he organized. He was assistant secretary of the American Commission to negotiate peace at Paris in 1918 and 1919, and in 1921 served as chief of the press section of the arms conference called by President Harding and Secretary Hughes.

S. E. ON. ING. PROF. Umberto Puppini, President; Marchese Giovanni Patrizi, Head of Refinery Division; and Gr. Uff. Ing. Oreste Jacobini, Vice-President and Technical Director, of the A.G.I.P., Rome, Italy, have all recently returned from a survey of the Mosul Oil Fields' operations in Iraq. Rumours are that a

Umberto Puppini

refinery may be built near the oil fields because of the heavy nature of the crude making transportation difficult. In this case the refined products would either have to be transported through a special pipeline or by tankcar on a railway to the Mediterranean.

JAMES H. HERBERT, formerly assistant manager of Industrial Relations, for Standard of Ohio, has recently been appointed Director of Industrial Relations for the White Star Division of Socony-Vacuum.

James H. Herbert

World Oil Production—Official Figures for 1934 and 1935 Revised

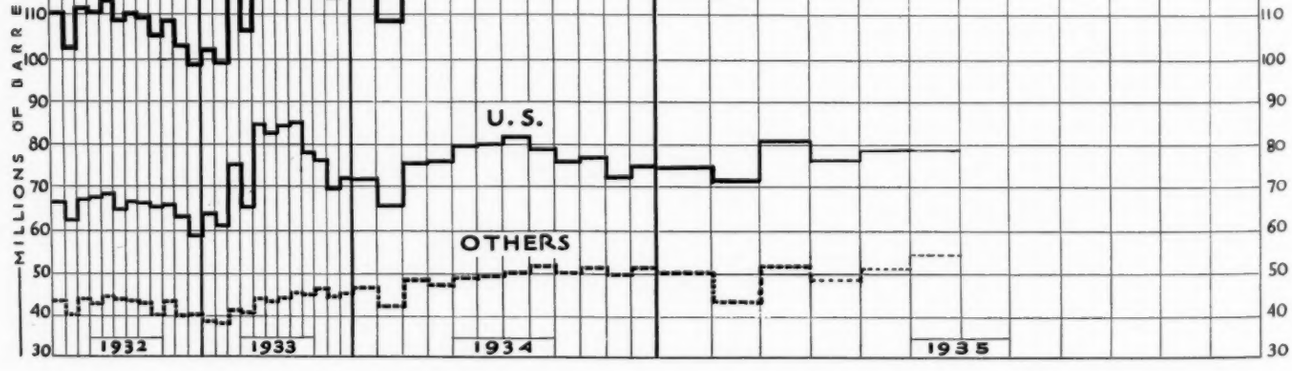
All figures furnished direct to WORLD PETROLEUM by Governments, except where otherwise specified
(Figures in U. S. Barrels—Conversion ratio 7 bbl. = 1 ton)

Country	July 1934	August 1934	September 1934	October 1934	November 1934	December 1934	January 1935	February 1935	March 1935	April 1935	May 1935	June 1935
United States	81,548,000	79,058,000	75,810,000	76,776,000	72,463,000	74,772,000	78,715,000	72,763,000	81,488,000	78,427,000	82,454,000	79,770,000[1]
Russia	14,297,500	14,287,700	13,924,400	14,260,000	14,388,500	14,638,400	13,358,100	12,704,300	14,139,300	14,058,200	14,280,000[1]	14,150,000[1]
Venezuela	12,193,307	12,505,304	12,381,159	12,591,390	12,274,794	12,420,296	12,818,414	11,287,605	11,703,825	11,869,900	12,175,022	13,075,118
Iraq[5]	12,006,127	12,006,127	11,618,510	12,006,127	11,618,510	12,006,127	425,000	1,631,000	2,258,123	556,500[1]	1,085,000[1]	4,200,000
Roumania	5,223,000	5,556,000	5,335,000	5,467,000	5,324,000	5,522,000	5,355,000	4,860,000	5,256,000	5,008,000	5,035,000	5,125,620[1]
Iran[2]	4,577,251	4,886,462	4,955,419	4,499,530	3,725,178	4,049,556	4,410,714	4,109,665	4,879,000	4,088,000	3,927,000	4,264,480[1]
Mexico	3,303,055	3,434,516	3,276,612	3,393,770	3,332,926	3,425,314	2,894,167	2,661,632	3,519,148	3,120,035	3,529,659	3,453,871
Netherland India	3,678,745	3,456,215	3,410,785	3,577,399	3,553,067	3,743,810	3,618,272	3,244,717	3,539,564	3,438,848	3,517,360	3,463,061[1]
Colombia[4]	1,646,739	1,691,314	1,627,632	1,646,293	1,633,654	1,554,172	1,653,647	1,141,696	1,466,821	1,377,299	1,486,896	1,518,460
Argentina	1,077,502	1,210,273	1,258,812	1,271,186	1,283,811	1,173,998	1,114,235	1,107,420	1,260,468	1,514,968	1,203,017	990,081[1]
Peru[6]	1,395,987	1,470,010	1,415,189	1,485,309	1,340,115	1,420,247	1,418,320	1,269,077	1,395,532	1,329,215	1,451,436	1,414,588
Trinidad	1,008,669	975,697	919,469	906,152	907,655	930,877	915,220	843,619	919,848	899,946	953,108	972,904
British India	785,751	762,959	752,451	779,011	763,091	746,410	781,170	708,159	773,572	700,000[1]	700,000[1]	700,000[1]
Poland	315,861	320,145	311,003	315,000	308,000	308,000	307,000[1]	297,000[1]	309,000[1]	330,000[1]	340,000[1]	314,490[1]
Brunei	271,243	263,781	246,554	225,561	227,815	258,909	269,794	241,927	264,390	267,603	277,550	269,290
Sarawak	164,206	161,504	155,400	156,800	152,600	158,200	183,300	136,500	152,250	151,067	155,400	150,850
Japan	131,397	129,326	124,870	125,229	119,970	131,059	171,441	151,797	164,174	167,728	154,150	157,738[1]
Egypt	135,156	131,061	124,502	123,235	116,326	115,731	112,147	100,086	104,419	94,955	100,555	99,260
Ecuador	141,474	140,944	136,033	141,079	133,490	140,000	147,315	139,555	151,366	145,212	147,245	137,806
Canada	120,772	114,778	114,242	122,056	113,228	117,113	124,654	111,545	120,537	108,506	122,636[1]	120,102
Germany[3]	208,145	219,961	198,366	227,605	219,485	228,767	287,518	223,153	277,942	240,464	285,747	257,369
France[1]	46,000	46,000	46,000	46,000	46,000	46,000	46,000	46,000	46,000	46,000	583,062	46,000
Others[1]	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Total	144,350,887	142,903,077	138,217,408	140,216,732	134,120,215	137,981,986	129,198,506	119,842,963	134,262,470	127,751,520	134,019,912	134,726,088

[1] Estimate. [2] Anglo-Persian Oil Co. figures revised; fuel oil returned to the ground has been deducted. [3] Thuringia estimated 7,000 bbl.; official figure for Prussia. Russian Sakhalin included with Russia. Japanese Sakhalin included with Japan. [4] International Petroleum Company's figures. [5] Iraq production estimated for 1934 on basis of total year's production represented by oil shipments through Tripoli and Haifa starting January 1935 plus oil necessary to fill line initially. [6] International Petroleum Company and Lobitos Oilfields Ltd. figures.

Official Crude Oil Production Figures for 1932 to 1935

	Total 1935 to June 30	Daily Average 1935 to June 30	Total 1934	Daily Average 1934	Total 1933	Daily Average 1933	Total 1932	Daily Average 1932
United States	471,019,000	2,602,300	909,107,000	2,490,704	898,874,000	2,462,670	785,159,000	2,145,243
Russia	82,689,900	456,300	168,648,700	462,051	149,901,900	407,950	149,719,000	409,070
Venezuela	72,929,884	402,927	142,072,329	389,239	120,882,802	331,186	119,596,512	326,766
Iraq	10,155,623	56,108	71,921,468	6,607	1,200,000	3,288	1,200,000	3,300
Roumania	30,924,620	170,850	62,006,000	169,879	50,971,200	139,647	50,491,205	137,954
Iran	25,678,859	141,872	52,663,782	144,284	49,581,280	135,840	45,122,455	123,285
Mexico	19,178,512	105,960	38,167,022	104,567	33,904,882	92,890	32,802,285	89,624
Netherland India	20,477,030	113,130	42,289,408	115,861	38,512,663	105,516	39,584,027	108,153
Colombia	8,644,819	47,761	17,340,724	47,509	13,157,127	36,047	16,384,956	44,768
Argentina	7,487,172	41,366	14,045,652	39,015	13,759,563	38,232	13,166,900	35,975
Peru	7,456,344	41,196	15,936,937	43,663	13,923,281 −	38,146	9,899,266	26,026
Trinidad	5,504,645	30,412	10,894,363	29,847	9,560,039	26,192	10,023,780	27,387
British India	4,200,000	23,204	8,997,399	24,650	8,721,655 +	23,893	8,600,312	23,500
Poland	1,897,490	10,483	3,697,617	10,130	3,858,085 −	10,570	3,905,230	10,670
Brunei	1,322,951	7,309	2,673,041	7,323				
Sarawak	929,367	5,134	1,948,044	5,337	2,289,472 −	6,273	2,274,043	6,213
Japan	992,698	5,484	1,484,962	4,068	1,377,761	3,827	1,575,333	4,375
Egypt	623,552	3,445	1,479,037	4,052	1,591,495	4,360	1,742,370	4,760
Ecuador	868,499	4,800	1,655,062	4,534	1,622,624 −	4,446	1,573,857	4,300
Canada	704,668	3,900	1,418,810	3,887	1,147,825 −	3,144	1,054,373	2,880
Germany	1,552,271	8,576	2,266,964	6,211	1,712,823	4,692	1,824,019	4,983
France	813,062	4,490	552,000	1,512	552,000	1,515	552,000	1,508
Bahrein			285,071	781				
Others	450,000	2,486	861,000	2,359	432,000	1,184	432,000	1,180
	776,501,166	4,290,062	1,502,617,452	4,117,293	1,417,534,489	3,884,022	1,296,712,823	3,544,940



World crude oil production in barrels by month, 1932–1935: Ratio of United States crude production to production in all other countries

UNITED STATES

	Daily Crude Oil Production bbl.	Daily Runs to Stills bbl.	Total Motor Fuel Stocks bbl.	Imports for week bbl.	California Shipments East for week bbl.
Week ending June 22..	2,743,000	2,755,000	62,010,000	1,627,000**	191,000
	478,500*				
Week ending June 29..	2,714,000	2,750,000	61,880,000	1,046,000**	61,000
	491,500*				
Week ending July 6....	2,708,500	2,715,000	62,050,000	594,000**	281,000
	498,500*				
Week ending July 13...	2,746,500	2,685,000	61,645,000	1,435,000**	none
	490,500*				

Underlined figures indicate improvement in statistical position—decrease in production, runs to stills, gasoline stocks and imports.

*Estimated total production of the East Texas field, official and unreported.

**Import figures include all oil imported, for domestic use and in bond for re-export, it being impossible to make the separation in weekly statistics.

July 28, 1935.
By wire from Tulsa.

THE DISCOVERY OF LARGE FLUSH PRODUCTION BY THE UNITED GAS PUBLIC SERVICE COMPANY IN CADDO PARISH OF LOUISIANA IS OF VERY GREAT IMPORTANCE TO THE OIL INDUSTRY, REGARDLESS HOW LARGE OR SMALL THE NEW FIELD OR FIELDS MAY PROVE TO BE, THOUGH PRESENT INDICATIONS POINT THAT THE RODESSA DISCOVERY IS IN THE MAJOR CLASS. THE IMPORTANCE IS DUE TO THE FACT THAT THE FIELD WILL PROBABLY DEVELOP INTO A TRI-STATE PRODUCING AREA, EXTENDING FROM LOUISIANA INTO TEXAS DUE SOUTHWEST AND INTO ARKANSAS DUE NORTHEAST. NEITHER LOUISIANA NOR ARKANSAS, NOW PRODUCING RESPECTIVELY AROUND 145,000 BBL. AND 30,500 BBL. PER DAY, HAVE PROVEN STATE ENFORCEMENT LAWS AND WITH LOUISIANA DOMINATED BY HUEY LONG THE PRORATION QUOTAS AND THEIR ENFORCEMENT IN THE NEW RODESSA FIELD WILL BE OF VITAL INTEREST TO THE WHOLE OIL INDUSTRY DURING THE NEXT FEW MONTHS. IF SERIOUS OVERPRODUCTION TAKES PLACE THE CONNALLY INTERSTATE SHIPMENTS ACT WILL BE UNDOUBTEDLY CONTESTED, IF THE STATE OF LOUISIANA WILL AT ALL COOPERATE WITH OTHER STATES IN CURTAILING ITS PRODUCTION TO THE DEMAND. HOWEVER WITH THE STATE IN FIRM POLITICAL HANDS IT IS HARDLY LIKELY THAT THE STATE OFFICIALS WILL JEOPARDIZE THE STATE'S INCOME BY IN EFFECT SPONSORING A CUT IN CRUDE OIL PRICES. ALSO CONTROL OF PROMISING ACREAGE IN THE HANDS OF FEW COMPANIES WILL EXERCISE A RESTRAINING INFLUENCE. THEREFORE THE PRESENT INDICATIONS ARE THAT THE STATE OF LOUISIANA WILL REQUEST A GREATER SHARE OF NATIONAL MARKETS EAST OF ROCKY MOUNTAINS, MORE IN LINE WITH THE NEW RESERVES, IF PROVEN, WHICH WILL CORRESPONDINGLY REDUCE ALLOWABLES IN TEXAS, OKLAHOMA AND KANSAS.

Passing of the New Deal?

THE staggering blow dealt by the United States Supreme Court to the New Deal legislation on May 27, 1935, when the National Industrial Recovery Act was held unconstitutional, was further accentuated when on July 16 the United States Circuit Court in Boston, Mass., declared the processing tax and the floor taxes (levies upon finished goods on hand when the tax became effective) of the Agricultural Adjustment Act (AAA) also unconstitutional. The court's ruling was in the test case brought by the Hoosac Mills Corporation. The government is planning a prompt appeal to the United States Supreme Court, but in view of the recent decisions of the Supreme Court it is quite doubtful that the decision of the Circuit Court will be reversed. The processing and the floor taxes were considered the foundation of the AAA since they provided the funds with which the Secretary of Agriculture compensated growers for curtailing crops and live stock production. The Circuit Court held that Congress did not have authority to regulate products which were in control of the state and that the taxes were an improper delegation of power; the Court stated in part that "if Congress can take over the control of any intrastate business by declaration of an economic emergency and a public interest in its regulation, it would be difficult to define the limits of the powers of Congress, or to foretell the future limitations of local self-government."

The importance of the decision is apparent since the Government is estimated to have collected already some $900,000,000 in processing taxes, which amount may be subject to recovery, unless Congress passes a bill, now under consideration, barring processing tax recovery suits. The great importance of the Circuit Court's decision to the oil industry is that it further stresses the current interpretation of the Constitution, as held by courts, that present efforts of the federal government to control intrastate commerce are unconstitutional. The desire of the Administration to localize the Boston ruling to New England cotton mills apparently failed when on July 18 Federal Judge J. J. Gore in Nashville, Tenn., temporarily enjoined the Collector of Internal Revenue from collecting AAA processing taxes from 19 concerns doing business in Tennessee.

The reverses suffered by the New Deal possibly presage a major political issue in the forthcoming presidential elections in 1936, that of extending federal economic control into the individual states and into intrastate commerce. The current issue, however, is very old and fundamentally it is whether federal government possesses the power to control minute problems of national life or whether the sovereign power is subject to limitations either of constitution or of common law. It is highly improbable that people in the United States will at this time approve very radical extension of federal jurisdiction, and any intensive drive for such extension of power will more than likely have the reverse effect of arousing public opinion for self-government within states.

In its attempts to get by the rulings of the courts the Administration has devised for the bituminous coal industry the Guffey-Snyder bill, referred to as a "little N.R.A.", under which the government may levy a tax upon the sale price or value of all soft coal mined and providing that 99 percent of such tax need not be paid by producers complying with the new "little" code; and also may prohibit producers from moving their products in interstate and foreign commerce. The constitutionality of the Guffey-Snyder bill is quite doubtful since it is not a revenue-raising measure, the tax being subordinated quite clearly to regulation; while prohibition, instead of only regulation, of shipments in interstate commerce will be probably ruled as excessive grant of power. President Roosevelt recommended the enactment of the Guffey-Snyder bill despite "reasonable" doubts as to constitutionality, but it is rather questionable that the Congress will accede to the request since the recent AAA decision apparently greatly influenced the Senate and the House of Representatives. The Guffey-Snyder bill, if passed and upheld in courts, will directly affect the oil industry since similar regulations could be easily imposed upon the oil business by the passage of an oil control measure patterned after the Guffey-Snyder bill.

The Congress continued in session and is not likely to adjourn until after September 1, though the passage of any oil legislation during the current session is practically out of the question. State governments are strongly and actively opposed to any laws curbing their powers, while the Department of the Interior and Secretary H. L. Ickes adopted the waiting policy of allowing the oil industry to run into another economic debacle before renewing their efforts. Thus it rests with the oil industry and with state governments effectively to control production, runs to stills and to maintain prices during the coming Autumn and Winter in order to avoid strict federal control legislation in the next session of Congress. The only legislation favored by the oil industry and by state governments is for the approval of interstate compacts and for some measure of relief from anti-trust laws.

The Wagner Labor Disputes Bill, also known as the National Labor Relations Act, discussed in the June issue of WORLD PETROLEUM, was passed by both branches of the Congress by July 1 and was signed by the President. The bill provides for the "majority rule" for employe bargaining and representation, for abolition of company unions, and it prohibits employers from contributing financial or any other support to labor organizations. Roger W. Babson in an excellent statement reflected the opinion of business men in the United States by saying that it may prove to be a

boomerang for the cause of labor. Mr. Babson stated in part: "Almost every enlightened employer believes in collective bargaining and the right of labor to strike. So my biggest criticism is not concerned in any way with the Wagner Act's recognition of this right, but with its unfairness in permitting coercion on the part of labor leaders and forbidding it on the part of employers . . . My second major objection is based on the premise that labor union legislation of this general type discourages employers and increases the number of jobless. Statistics show that directly after the enactment of such legislation there is a sharp increase in the sale of all kinds of labor-saving machinery. Employers, afraid of labor-leader domination, are determined to get on with fewer workers. Their total pay roll under the new set-up may be less than before and the number of technologically unemployed will be increased . . . this legislation . . . will force employers to be more careful whom they employ."

The Wheeler-Rayburn utility holding company bill, reported in detail in the May issue of WORLD PETROLEUM, was defeated in its original form and is again under debate in the Congress, which incidentally is currently sidetracked investigating lobbying by utility interests and by the Administration, against and for the Wheeler-Rayburn bill respectively.

Texas Conservation Laws Upheld

ON JULY 2 a Three-Judge Federal Court sitting in Houston refused to grant a group of East Texas refiners an injunction to restrain the Texas Railroad Commission from interfering with shipments of about 75,000 bbl. of crude oil. Attorneys for the defense gave notice of appeal to the United States Circuit Court. The court did not pass on the constitutionality of the confiscation law as the judges held that this point cannot be decided until the state seizes or attempts to confiscate the crude oil belonging to the plaintiffs. In the same ruling the court held proration orders of the Texas Railroad Commission legal and valid.

On July 3 the 8th Court of Civil Appeals sitting in El Paso, in a case transferred from Texarkana, also upheld the validity of Texas oil conservation laws in deciding six suits in favor of the state, sustaining judgments for $15,750 in penalties for alleged production of "hot oil."

On July 9 the Attorney General's department and the Texas Railroad Commission ordered confiscation of some 173,000 bbl. of crude oil produced in violation of state laws. Sale of the confiscated crude was ordered by the Gregg County sheriff after ten days of notice. Defendants were the Superior Petroleum Corporation with 133,000 bbl. and J. R. Tolbert with 40,000 bbl. On July 18 a suit was filed against the Phoenix Refining Company and L. R. Hepworth asking for confiscation of 52 tank cars of crude oil without legal tenders in Houston, the court restraining the defendants from moving the cars.

On July 19 the Texas Railroad Commission issued an order reducing the state's allowable production from 1,064,400 bbl. to 1,001,427 bbl. per day effective July 22. The order was issued to curtail runs to storage and was not influenced by crude oil price considerations, since prices remained generally steady due to the period of high consumption. The order of Texas Railroad Commission is a remarkable evidence of the desire of the state government to limit its production to economic demand, and if a corresponding reduction is made by producers now, and if similar orders are issued and followed during the forthcoming season of slow demand, then the stabilization of the oil industry in the southwest may be considered an established fact. Current production of "hot oil" in the East Texas field is estimated at around 30,000 bbl. per day, or an amount easily absorbed locally, principally in the form of third grade gasoline selling in the East Texas area at around 10 to 12 cents per gallon.

Prices Seasonally Firm

THE DEVELOPMENTS of the last month definitely indicated that crude oil and gasoline prices will be maintained unchanged during the balance of the motoring season, but that the subsequent trend will be entirely dependent upon the enforcement of the state proration orders in Texas and in California, and upon the willingness of the states to lower their quotas in proportion to the reduced demand. Current indications are that states in the Mid Continent will reduce their allowables and that such quotas will be enforced. California, however, remains an unknown and disturbing factor and if overproduction continues in the Los Angeles basin oil fields, locally low motor fuel prices will prevail in southern California. Court decisions, as already reported, continued in favor of the Texas Railroad Commission and against the "hot oil" producers and thus unless a major upset occurs the "hot oil" production in the East Texas field will continue to affect only a limited territory, and only in the marketing of the third grade product.

During the past month refinery gasoline quotations remained unchanged, while motor fuel prices at service stations were generally maintained. Price reductions in service station quotations, influenced by "price wars," were made in Los Angeles area by the Standard Oil Company of California, a cut of 1 cent on July 1; in Minneapolis, a cut of 1 cent, and in Detroit, a cut of 2 cents, both by the Standard Oil Company of Indiana on July 13; while in Montreal, Canada, prices slipped 6½ cents per gallon when an independent marketing concern began distribution of Roumanian gas at cut prices. By the middle of July a serious price cutting outbreak occurred in Chicago with prices dropping 2 cents a gallon under the posted prices, though major companies continued to maintain former postings. On July 2 and 3 the Standard Oil Company of Louisiana advanced service station prices 2 to 2.5 cents per gallon in Chattanooga, Nashville and Knoxville. The dominating influence at the end of July was the extremely heavy seasonal movement of gasoline both in trade channels and to the consumer favored by excellent weather throughout the country and by the vacation season. Natural gasoline remained steady and unchanged during the past month in anticipation of the Autumn and Winter demand, but kerosenes lost around ¼ of a cent per gallon during the same period of time.

Posted crude oil prices during July remained firm and unchanged at $1.00 per barrel for 36 gravity Mid Continent crude and $1.00 flat per barrel for East Texas crude. Local reduction of 10 cents per barrel took place on July 16 in Pennsylvania where the Bradford grade was cut to $1.95 per barrel, and in Eureka Pipe Line lines to $1.62 per barrel. On June 29 in Southwest Texas the Saxet and Refugio grades of crude oil were cut 5 cents per barrel to 80 cents, and the Mirando crude was also cut 5 cents per barrel to 75 cents, these minor reductions being due to local oversupply.

Tank wagon/service station motor fuel prices per gallon, regular grade, including all taxes, in representative districts in the middle of July were: 14.55/18.3 cents in metropolitan New York (13.3/16.8 cents in Newark, N. J.); 11.0/12.5 cents in Boston, Mass.; 12.0/13.5 cents in Providence, R. I.; 15.5/17.5 cents in Chicago, with some stations quoting 2 cents under the posted prices and possibly presaging downward readjustment by all marketers; 17.0/19.0 cents in Ohio; 16.5/18.5 and 11.5/13.5 cents in San Francisco and Los Angeles respectively, with some independents selling third grade motor fuel for as low as 9.5 cents per gallon in Los Angeles, all taxes included; 16.0/18.0 cents in Oklahoma; 15.0/17.0 in Dallas, Forth Worth and Houston, Texas, with third grade product from the East Texas field selling down to 10 cents per gallon; 15.2/17.2 cents in St. Louis and East St. Louis; and 18.5/20.5 cents in Montreal, Canada; all with a 2-cent differential for premium grade.

Refinery gasoline quotations in the Mid Continent area remained virtually unchanged during the past month. Refinery gasoline was quoted on July 20 at 4¾–4⅞ cents per gallon for 58–60 U.S.M. grade 62.9 and below octane rating in Group 3, Oklahoma market; 63.0–70.9 octane rating, U.S.M., "regular" grade, was quoted at 5⅝–5⅞ cents per gallon; and 71 and above octane rating, U.S.M., "premium" grade was nominally quoted at 5⅞ cents per gallon. East Texas markets continued strong with prices on a par with Group 3 quotations. On the East Coast, at Bayonne, U.S.M. grade 60.0–64.9 octane rating gasoline was quoted unchanged at 5¾ cents per gallon (3.40 cents gold*). Gulf Coast prices for export declined ¼ of a cent per gallon below June 20 quotations and July were around 5 cents per gallon (2.95 cents gold*) for grade 58–60 U.S.M.

Natural gasolines firmed up slightly during the last month with the approach of Fall demand and on July 20 grade 26–70 was quoted at 3⅛ cents per gallon (1.85 cents gold*) in Oklahoma; at 3 cents per gallon (1.77 cents gold*) in North Texas; and at 3¼–3⅜ cents (1.96 cents gold*) in North Louisiana.

Kerosene prices further lost about ¼ of a cent per gallon during the past month. On July 20 grade 41–43 w.w. was quoted at 3⅜–3½ cents per gallon in Group 3, Oklahoma market; and at 4⅞–5 cents per gallon (2.86 cents gold*) on the East Coast at Bayonne.

* U. S. Dollar at 41 percent discount.

Gulf Coast prices for export remained unchanged at 3⅞ cents per gallon (2.29 cents gold*) for 41–43 p.w. grade and at 3⅞–4 cents per gallon (2.36 cents gold*) for 41–43 w.w. grade.

Exports Increase Sharply

DURING MAY, 1935, total gross imports of all petroleum products into the United States amounted to 5,074,000 bbl., 163,600 bbl. per day, as compared with 4,450,000 bbl., 148,400 bbl. per day, imported during the preceding month; out of this total during May, 1935, 3,525,000 bbl., 113,800 bbl. per day, were imported for domestic use and 1,549,000 bbl., 49,800 bbl. per day, were imported in transit either for refining and re-export or for use in vessels in foreign trade. During the preceding month, April of 1935, 2,770,000 bbl., 90,200 bbl. per day, were imported for domestic use and 1,743,000 bbl., 58,200 bbl. per day, were imported in bond as indicated above. Crude oil imported for refining and re-export amounted in May, 1935, to 474,000 bbl. Therefore during May the net imports for domestic use continued to average well within the federal recommendation of 108,400 bbl. per day.

Exports of all petroleum products during May, 1935, increased 16.72 percent above the daily rate of the preceding month, reaching 9,746,000 bbl., 314,000 bbl. per day, as compared with 8,081,000 bbl., 269,000 bbl. per day, shipped during April, 1935. The May, 1935, total exports were slightly in excess of the shipments in May of 193[illegible] when 9,639,000 bbl., 310,000 bbl. per day, were exported. For the first five months of 1935, however, the total exports of 43,086,000 bbl. lagged considerably behind the exports during the same period of 1934 when 46,112,000 bbl. were shipped, or a decline of 7.01 percent. Exports of crude oil from the United States during May, 1935, were unusually high, reaching 4,613,000 bbl., 149,000 bbl. per day, as compared with 3,776,000 bbl., 125,000 bbl. per day, shipped in April of 1934. In May of 1935 crude oil exports constituted 47.4 percent of the total exports of all petroleum products.

Production and Runs to Stills

CRUDE OIL and natural gasoline production during June, 1935, the first full month of operations without the federal regulation under the N.R.A., averaged about 2,840,000 bbl. per day, 76,000 bbl. per day above the crude oil and natural gasoline production during the preceding month when 2,764,000 bbl. per day was produced; and it was also about 70,000 bbl. per day above crude oil and natural gasoline production in June of 1934, an increase of 2.53 percent. The June, 1935, average daily crude oil production exceeded the federal recommendations by about 90,000 bbl. per day, the bulk of overproduction being in California, which exceeded its quota by 1,315,000 bbl., while Texas overproduced but 220,000 bbl. Kansas underproduced 234,000 bbl. during June and Oklahoma underproduced 20,000 bbl. during the same month. While the attention of the industry during June was focused on California, which overproduced daily 43,800 bbl., the very important and vital achievement of the State of Texas, which held its production down to within 7,320 bbl. of the federal recommendations per day, passed without much publicity. Effective control of production in Texas means in fact stabilization of the producing branch of the oil industry in the Southwest, since California's difficulties will probably be confined to southern California only, and are not likely to affect markets east of the Rocky Mountains.

Crude oil runs to stills during June, 1935, averaged about 2,700,000 bbl. per day, or some 100,000 bbl. per day above runs to stills during the preceding month when 2,594,000 bbl. per day were refined.

Total stocks of all petroleum products declined during May, 1935, by 1,198,000 bbl. to a total of 568,340,000 bbl., indicating daily gross withdrawals of 39,900 bbl.

Record High Demand

INDICATED domestic demand for motor fuel during May, 1935, followed the example of the preceding month and established an all-time record for May; averaging 1,261,000 bbl. per day, a seasonal increase of 4.82 percent above the daily average during April, 1935, when 1,203,000 bbl. were consumed per day; the domestic demand during May, 1935, was 18,000 bbl. per day above the domestic motor fuel consumption in May of 1934, an increase of 1.45 percent; 164,400 bbl. per day above the domestic motor fuel consumption in May of 1933, an increase of 15.00 percent; and 73,500 bbl. per day above the domestic motor fuel consumption in May of 1931, the peak year before 1934, an increase of 6.20 percent. It must be very particularly noted that April and May, 1935, domestic demand was definitely and seriously handicapped by very unfavorable rainy unseasonal weather and by the hesitancy of dealers to buy even day to day stocks pending the extension of the federal 1-cent excise gasoline tax, since extended, and that the June to September domestic motor fuel demand may easily exceed the most optimistic estimates.

The NEW YORK TIMES weekly combined business index slipped substantially down to 79.5 in the week ending July 6, 1935, from the June average of around 84, but quickly recovered to 83.6 in the week ending July 13. The decline in business activity is seasonal and the trend should be reversed in September, if not before, due to earlier date of the coming out of new automobile models, now scheduled for November. The NEW YORK TIMES index stood at 79 on July 1, 1934; at 97 on July 1, 1933, during the brief uprush and before it slipped to 78 by September 1, 1933; at 65 on July 1, 1932; and at 86 on July 1, 1931. The retarding influence on business was the fact that the Congress continued in session with a number of bills of questionable value and constitutionality before it.

The daily rate of exports of motor fuel increased very substantially to 69,000 bbl. in May, 1935, 40.80 percent above the preceding month; 12.20 percent above the motor fuel exports in May of 1934; unchanged from May of 1933; but 56.0 percent under the motor fuel exports in May of 1931.

On June 1, 1935, motor fuel stocks at refineries, plants, terminals and in transit, inclusive of natural gasoline, amounted to 61,173,000 bbl., a decline of 2,631,000 bbl. as compared with stocks on hand on May 1, 1935, indicating that during May motor fuel demand exceeded supply by 84,750 bbl. per day.

Field Developments—Texas

THE ANAHUAC FIELD in Chambers County on the Gulf Coast discovered on March 3, 1935, by the Humble Oil and Refining Company assumed major proportions when G. H. McCarthy and R. A. Mason's No. 1 R. M. White in Jas McGahe survey, 3 miles north from the discovery, drilled 128 ft. of saturated sand from 6,926 ft. to 7,054 ft. and was completed for 1,080 bbl. per day initially through ¼-inch choke. The Anahuac field is at this time 3 miles long and about 1 mile wide on its south end where Humble Oil and Refining Company completed to date seven oil wells. Undoubtedly many more locations will be announced promptly, subject to order of the Texas Railroad Commission requiring spacing of one well to each twenty acres. The producing sand formation in Anahuac is in the Frio, with sand thickness ranging up to 240 ft., including both gas and oil saturated sections; the water level has been established at about 7,140 ft. The new field is limited only in the western direction where Turnbull and Irwin No. 1 Sudendorf, three miles due west from the discovery well, was completed as a dry hole with a total depth of 7,657 ft. A very important factor in Anahuac is that the G. H. McCarthy and R. A. Mason's extensioner is structurally fully some 70 ft. higher than the highest wells of the Humble Oil and Refining Company due south, thus suggesting a really large field, the value of which will be further enhanced by thick body of gas and oil saturated sand.

The Anahuac field is located about 65 miles southeast from Houston and six miles east from Anahuac on Galveston Bay. The new field is being connected by a 6-inch pipeline of

Effect of Federal Proration Recommendations in Principal Oil Producing States

	Sept. 1933 to June 1935 Cumulative Overproduction		June 1935 Over-production	July 1935 Federal Recommended Quota	Daily Average Production for week ending		Aug. 1935 Federal Recommended Quota
					July 6	July 13	
	bbl.	% of total	bbl.	bbl.	bbl.	bbl.	bbl.
Texas	37,785,000	54.5	220,000	1,064,400	1,099,000	1,085,000	1,024,000
Oklahoma	10,440,000	15.1	*	517,400	491,500	521,500	512,000
California	9,138,000	13.2	1,315,000	520,000	545,500	567,000	510,000
Kansas	2,463,000	3.6	**	155,600	145,000	146,500	148,000
United States	69,252,000	100.0	1,673,000	2,660,000	2,708,500	2,746,500	2,600,000

* Oklahoma underproduced 20,000 bbl. in June.
** Kansas underproduced 234,000 bbl. in June.

the Humble Pipe Line Company with the company's large refinery at Baytown, but 30 miles due northwest from Anahuac field. Thus the strategic location of Anahuac in regard to refining and shipping facilities is ideal.

The Humble Oil and Refining Company discovered the Anahuac field after working the area with reflection seismographs and torsion balances. Humble is by far the largest operator in the new field. If the proven area is to be very tentatively placed at 8,000 acres, then Humble Oil and Refining Company owns at least 4,000 acres in the proven territory; Sun Oil Company owns 500 acres (possibly considerably more); Gulf Oil Company owns 600 acres and McCarthy and R. A. Mason own 1,076 acres. The Anahuac field will be undoubtedly the most carefully watched new field along the Gulf Coast during the balance of 1935 and in 1936, and it will probably witness a most active drilling development campaign.

The Standard Oil Company of Indiana entered actively and on the major scale the producing branch of the oil industry on the Gulf Coast by setting up a new subsidiary with headquarters in Houston, the Pan American Production Company, which will supply the company's Texas City refinery near Houston. The purchase by the Standard Oil Company of Indiana of the producing properties of the Yount-Lee Oil Company for around $50,000,000 is reported to be again under consideration.

Louisiana — Rodessa

A DISCOVERY which promises to develop into a major field and which may mean a large regional development was made by the United Gas Public Service Company in its No. 1 I. L. Young in section 21, T. 23 N., R. 16 W. in Caddo Parish of northern Louisiana and 40 miles north from Shreveport. The discovery well is located in the Rodessa gas field which produced formerly only gas from 5,500 to 5,950 ft. from the Öolitic limestone of Glen Rose formation in Upper Trinity series. The new well was completed at 6,048 ft., also in the Öolitic limestone of Glen Rose, and it is estimated good for around 15,000 bbl. of crude oil and 25,000,000 cu. ft. of natural gas initially per day; it represents apparently a flank type of production with structurally higher portions carrying gas, therefore the question of the size and importance of the new discovery will depend upon the areal extent of flank production and upon the thickness of the oil saturated limestone. The crude oil in Rodessa's new field tests 43.5 gravity, but it yields only 27.5 percent of 62 gravity straight-run gasoline with a very low octane rating of 42; other constituents are 17.0 percent of 47.8 gravity kerosene, 45.0 percent of 37 gravity gas oil and 9.0 percent of 16 gravity fuel oil. Standard Pipe Line Company (S.O.La.) is connecting the new discovery with its Baton Rouge trunk line, which passes within eight miles of the new well. United Gas Public Service Company and R. W. Norton of Shreveport are the largest lease owners in the vicinity of the new discovery.

BASIL B. ZAVOICO

MEXICO

MEXICO CITY

ENGINEER Pascual Ortiz Rubio, ex-president of Mexico and newly appointed president of Petromex, government-controlled oil company, announced his intention of carrying on in full detail the company's program of development. The new board of Petromex, representing the government's interest, consists of: Lawyer Eduardo Suarez, Minister of Finance, General Rafael Sanchez Tapia, Minister of National Economy, Engineer Manuel Santillon, under-secretary of National Economy, and Jose Noriega, ex-chief of the Petroleum Department, whose able interpretation of the Mexican oil situation was published in the July issue of WORLD PETROLEUM.

ALL OIL lands that are covered by concessions that were obtained illegally or in irregular manner are to be incorporated in the federal petroleum reserves and henceforth a uniform procedure is to be followed to prevent abuses and irregularities in the granting of franchises for working the subsoil, the Ministry of National Economy announces. The Ministry's work of checking up on all oil concessions, which was started some months ago, is far advanced. Concessionaires who have failed to pay taxes on their oil lands are liable to lose such properties, and such tracts will be included in the federal reserves.

DOUGLAS GRAHAME

CANADA

Imports

IMPORTS of crude petroleum into Canada for the months of April and May 1935 were as follows: April, 40,446,492 gallons valued at $1,227,571; May, 113,131,917 gallons valued at $3,357,072.

The figures for May show an increase of 14,251,982 gallons valued at $434,902 over May of last year.

Imports of gasoline for April and May of this year were as follows: April, 1,194,867 gallons valued at $96,702; May, 1,256,328 gallons valued at $112,561. This year's May figures also show an increase over last year's figures, which for the month of May were 1,125,337 gallons valued at $105,950.

New Developments

ST. LAWRENCE Service Stations Limited have caused considerable upset recently in Montreal and vicinity by introducing a gasoline selling at 20c. a gallon, tax paid, and even less than that. That was the figure they started with, but it has since been reduced even further. This company was formed nearly a year ago with a Dominion charter, and is at present building a storage plant and refinery in the east end of Montreal. According to an official report, the company is at present marketing a gasoline refined in Roumania, and it is presumed that when the Montreal refinery is completed, the refining process will be transferred to that city, the crude oil only being imported. The normal price for second grade gasoline is 27 cents a gallon, but with this new element in the price war, all other companies have reduced their prices to try to compete with the new company. Investigations are now going on regarding this new departure.

THE BRITISH American Oil Company has purchased Putnam Bros., with head office at St. John, N. B., and in June the B. A. oil tanker BRITEMLUBE docked at that port with a cargo of 750,000 gallons of Never-nox gasoline. The B. A. Oil Company established a refinery at Montreal some time ago. This was followed by two in the west of Canada, and now

by the above mentioned distributing point which will supply a large district of Nova Scotia and New Brunswick.

ONTARIO shareholders have acquired control of Merland Oil Company of Canada. The board of directors that was in office before the annual meeting was completely voted out, and a new board put in. The head office remains at Calgary. The Alberta Government conducted an investigation under the Security Frauds Prevention Act into a deal in which the former vice-president sold the company 320 acres of oil lands at Twin Dome in exchange for 150,000 Merland shares. It was thought that this deal was put through before the annual meeting so that the group then in power could retain control.

A REFINERY, to cost between $400,000 and $500,000, is to be built in Burnaby, British Columbia, by the Standard Oil Company of British Columbia, Ltd. Distillation units will have a charging capacity of 2,000 bbl. a day. The modern storage tanks include the pontoon type floating roof tanks and an 80,000 bbl. storage tank, as well as other smaller ones. Five new service stations are under construction in Vancouver and sales through dealers and distributors are being arranged. It is expected that the refinery will be completed by December 1st.

NET PROFIT of Texas-Canadian Oil Corporation for the year ended April 30th, 1935, amounted to $13,415, equivalent to 1.67 cents per share. Operating profit totalled $54,958. A deficit of $8,407 was shown in working capital account, current assets as of April 30th last amounting to $21,054 as against current liabilities of $29,461. In addition there were deferred liabilities of $48,443 payable in monthly instalments during the current year. P. D. Bowlen, president, in reviewing operations for the year, stated that the company's progress in drilling new wells was greatly retarded owing to the difficulty in obtaining permits from the State of Texas. Despite this setback, the company had 28 wells in production at the end of April as compared with six wells at the end of the previous fiscal year. Six additional wells have been completed since the end of April.

ONE OF the most important drives in the history of the west in search for oil and gas prospects is being made this season. Four geological survey parties are being sent out from Edmonton, Alberta, to map and make structural studies of an area of 4,000 square miles extending east to Battleford, Saskatchewan. Dr. G. S. Hume of Ottawa will have general supervision of the work. One party will operate near Edmonton, another in the Wainwright district, another in the Vermilion district, and another in the district between Lloydminster and Battleford. Such well-known fields as Viking with its extension into the Kinsella area, Fabyan, Wainwright and Lloydminster will be covered in the season's program. Water wells which were bored will also be reported upon.

R. C. ROWE

VENEZUELA

Venezuelan Production of Petroleum to May 1, 1935

(Barrels)

Companies producing	January	February	March	April
Lago Petrol'm. Corp'n.	4,181,232	3,599,032	3,475,347	3,381,497
Standard Oil of Venez.	1,770,544	1,520,339	1,603,212	1,929,189
Venez. Oil Conces'ns.	3,105,790	2,825,653	3,080,616	3,013,312
Caribbean Petrol. Co.	1,311,143	1,148,907	981,648	895,920
Colon Developm't. Co.	478,997	395,720	362,943	431,141
Venez. Gulf Oil Co.	1,608,414	1,490,593	1,811,719	1,871,576
Brit. Control'd. Oil Co.	80,038	71,388	76,131	76,040
	12,536,158	11,251,652	11,391,616	11,598,675

THE FIELD of the Standard's subsidiary, the Creole Petroleum Corporation, in the state of Monagas, eastern Venezuela, continues to show the rapid increase of development and production which prevailed during the year 1934. While its Cumarebo field, in the state of Falcón, northern Venezuela, shows a slight decline in production, the quality of the oil continues to rule at the same high figure—about 47 deg. gravity.

The Quiriquire production in April amounted to 1,692,448 bbl., a daily average of 56,415 bbl., produced from 90 wells, of which 72 were natural flow and 18 by pump. Four new wells were completed in this field during the month, with an aggregate initial production of 7,127 bbl. daily. The daily average production of this field during April exhibits the remarkable increase over that of March of 12,667 bbl. Its total production to May 1, 1935 was 35,689,479 bbl.

The production of the Cumarebo field during April amounted to 235,836 bbl., from 44 wells, all natural flow; a daily average of 7,861 bbl. Total production of the field to May 1, 1935 11,859,127 bbl.

THE STANDARD'S operating company in the Quiriquire and Cumarebo fields is the Standard Oil Company of Venezuela, whose entire stock is owned by Creole Petroleum.

The recently published annual report of the Creole company, for the year 1934, reflects the rapid development of its Venezuelan fields in the marked increase of net earnings. These amounted to $5,315,254.47, an increase of $1,209,154.94 over the preceding year. The company's produced and royalty oil amounted to 19,390,275 bbl., an increase of 5,522,226 bbl. above the figure for 1933.

The report notes that, during the year 1934, 37 new wells were completed in the Quiriquire field, and 26 new wells in the Cumarebo field. At the year's close, 8,857,000 acres of oil concessions were held by the Standard Oil Co. of Venezuela.

Barco Concession, Colombia

INFORMATION from reliable sources, respecting operations over the Colombian border indicate that Petrolea No. 6A had been drilled to a depth of 1,065 ft. by early April. Owing to defective cementation, discovered on proceeding to drill out the cement plug, the Gulf company found it necessary to pull out the 6⅝ inch casing, in order to recement the same.

Petrolea No. 7 at a depth 1,467 ft. started producing in mid-April. After the drill pipe was pulled out, at 1,369 ft., the well had an initial production of 400 bbl. per day. The well was shut in for a few hours and when reopened flowed 300 bbl. of clean oil in 18 hours and a slight addition to the depth resulted in doubling the production. The well was then drilled to completion at 1,467 ft., and showed regular production, at the rate of 1,150 bbl. daily of 45 deg. A.P.I. gravity. The well was then closed in.

Railroad was completed to Petrolea No. 3 and the company began to move in material in April, and to lay water and fuel lines.

Work was suspended on Petrolea No. 8 pending completion of No. 6A; a spur was being cleared for the railroad, leading to Petrolea No. 9.

Oro No. 2 was spudded in on April 25th. An 18½ inch hole is being drilled. An eight foot seam of coal is being worked near the well, giving about 16 tons weekly, to provide boiler fuel. Heavy rains have caused delay in the work.

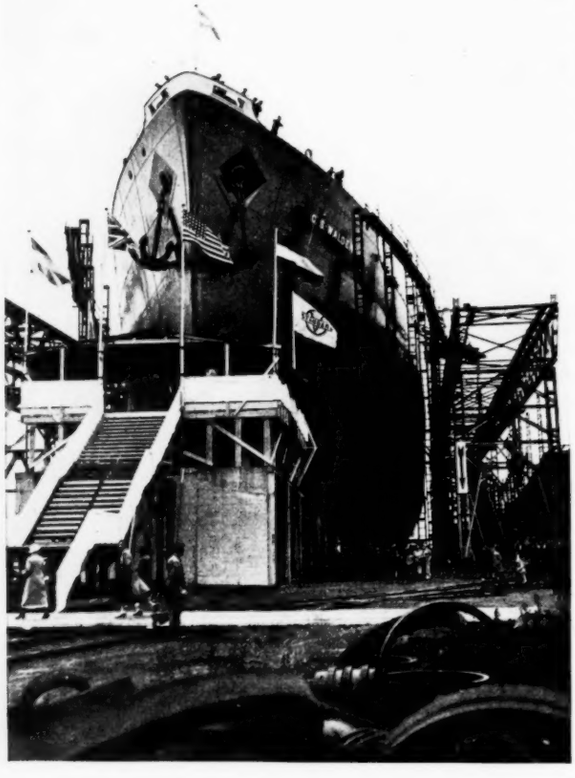
Less trouble is experienced from the Motiloni Indians, although they are still seen near the camps and do some stealing. The company forbids shooting at them unless attacked, in the hope of establishing friendly relations.

C. N. CLARK

SHIPPING

MARINE men in Great Britain are busy discussing the contract which has recently been placed with Messrs. John Brown on the Clyde by the Anglo American Oil Co. for a lubricating oil carrier of outstanding characteristics. This is one of the few tankers of modern type which have been constructed at the John Brown establishment and is certainly one of the largest. Shipbuilding men over here are also recording the fact that not many vessels, exclusively for carriage of lubricating oil, have been constructed on this side of the Atlantic. The official announcement of the order which the Anglo American Oil Co. has placed is stated to "mark a further step in the modern trend of specialisation", from which somewhat ambiguous statement, one may gather that she incorporates many new features in her design. She has been especially built for the transport of the Company's range of lubricating oils including the recently introduced Essolube and will have a cargo capacity of 2,500,000 gallons. Unlike the conventional ship of her kind, the vessel is to be built with a deep double bottom ballast tank, arranged under the cargo tanks. This does away with the necessity of carrying water ballast in the cargo compartments on the outward trip. In all there are to be twenty seven separate cargo tanks so that many different grades of lubricating oil can be carried. The cargo pumping installation is of special type and comprises eight completely independent pumps and pipe line systems, arranged in such a way that the pumps used for light oil are never used for heavy oil or vice versa. The use of a common pump and pipe line for widely differing grades is in this way rendered unnecessary. There are, however, special heating arrangements provided to keep the oil at the most suitable temperature. Special attention has been given to the hull design and it is stated that the design incorporates about 700 tons more steel than that of the conventional tanker of equivalent size. Propulsion is to be effected by a Diesel engine. The well known Doxford opposed piston 2-cycle design which has proved so popular in many tankers constructed in America, particularly at the Yard of the Sun Shipbuilding Company which holds the Doxford licence in America. Special attention on the new ship is to be devoted to quarters for crew and it is stated that the speed in service under fully loaded condition will be at least 12 knots. She thus follows the present day trend in tanker consideration to take advantage of the greater power which can be locked up in no increasing space in Diesel engines and which can give additional speed without much additional fuel consumption. The ordering of the Anglo American tanker has long been anticipated and it is known that bids for its construction were asked from a number of yards throughout Europe. Since the Anglo American fleet is quite in need of replacement of old units it may be taken that the ordering of this very special type vessel marks the beginning of a further constructional programme. One immediate Post-War vessel of their fleet, fitted with Vickers Diesel engines was sold last year for a very small sum for scrap. This contract, it is hoped by shipbuilders over here, may therefore, mark the beginning of yet a further rival in the important business of bulk oil carrier construction.

Launching the G. S. Walden, 15,000 Ton, 12½ knot tanker, in Holland for Oriental Tankers, Ltd., an affiliate of Standard-Vacuum



FORTY-ONE tankers aggregating 328,036 tons gross (about 525,000 tons d.w.) are now under construction, according to the June Lloyd's Register of Shipping. Six are steam and the rest Diesel driven. Total world shipbuilding aggregates 1,282,531 tons gross, so tankers form an important part of the tonnage on the stocks.

TANK men in Great Britain are well impressed by the fifth revised and enlarged edition of OIL TANK STEAMERS AND MODERN MOTOR TANKERS by Captain H. J. White. This is published at 15/- by Brown Son & Ferguson, the Nautical Publishers of Glasgow, and claims to be the standard manual on the transportation of oil, a claim which in fact is no exaggerated one, for it deals with all practical problems which the oil tank man wants to know. It is not specifically concerned with technical details of design and layout—in fact only a few early chapters are devoted to those characteristics of a tank ship which are more or less common property. Where it is useful, however, is in its later chapters dealing with the actual handling of oil on board, with fire causes, methods of detection and prevention, with official enquiries into cause of same, with dry docking and tank testing, oil separators, stranding and jettisoning of cargo, pipe lines for loading and discharging, the construction of vertical tanks, the arrangement of pipe lines on vessels with three longitudinal bulkheads, carriage of lubricating oil and many other matters. The book has been enlarged by the addition of 18 new chapters, making 61 in all. Eighteen types of tankships are described by chapters and diagrams and these are placed in rotation to show the evolution of tanker construction from 1885 to 1933. There are eight chapters on the carriage of various grades of petrol products, creosote and molasses, while the new chapters include details concerning specific capacity, viscosity, etc. The addition of a full chapter on overland pipelines and floating pipelines and method of use is very interesting in view of the development of new oil ports to take the oil from the Iraq pipeline.

A. C. HARDY.

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British Oil Imports

BRITISH imports of petroleum and products during June continued to show improvement and, despite the shorter month, exceeded total imports for May. The half year's figures, now available, indicate a new high figure for six months imports. Arrivals of Iraq crude, which have been a feature of these statistics this year, offset a decline in shipments from Iran (Persia). Motor spirit and fuel oil, originating in Iran, however, showed an increase in June. American lubricating oil shipments continued to exceed imports of that product from other sources.

British Oil Imports by Products

Barrels

	June 1935	Six months to June 30 1935	Six months to June 30 1934
Lamp oil	281,657	2,756,857	3,122,171
Motor Spirit	3,088,773	18,319,316	15,749,686
Lubricating oil	193,570	1,382,970	1,470,400
Gas oil	187,630	1,522,658	1,876,028
Fuel oil	1,883,000	9,715,514	8,634,657
Other sorts	53,542	256,086	335,314
Total products	5,688,172	33,953,401	31,188,256
Crude	1,938,714	7,418,314	7,153,086
Total imports	7,626,886	41,371,715	38,341,342

World Petroleum Abstracts

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Industry.

Dr. O. W. Wilcox

Petroleum Geology

EXTRATERRESTRIAL HYDROCARBONS.—F. M. Van Tuyl and Ben H. Parker, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 6, pp. 900–902.

The astronomers have lately reached the conclusion, based on spectroscopic research, that methane is the principal constituent of the atmospheres of the major planets: Jupiter, Saturn, Uranus and Neptune. The "Great Red Spot" on Jupiter is very possibly an island of solid hydrocarbon or ammonia floating in a vast hydrocarbon ocean as extensive as the planet's surface itself. By reasoning from analogy, it is suggested that hydro carbons may have been present in the primordial earth, though it is admitted that convincing evidence has not been presented to prove that commercial accumulations of petroleum and natural gas have originated from such a source.

PETROLEUM DEVELOPMENT IN AMERICA.—David White (deceased), in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 3, pp. 469–502.

A very readable account of general petroleum history, especially the earlier history of petroleum in the United States.

GEOLOGY AND POSSIBILITY OF DEEP SAND OIL AND GAS PRODUCTION IN NORTHWESTERN PENNSYLVANIA.—C. R. Fettke and S. H. Cathcart, before 5th Penn. Mineral Industries Conference, State College, April, 1935.

The results of drilling in the deep horizons of New York, Ohio and Pennsylvania and the relation between existing fields and the regional structure is shown graphically. The stratigraphy of the exposed rocks is summarized by a series of vertical sections and their structure is, so far as it has been determined, shown by contours. The subsurface stratigraphy is shown by a selected series of sections that are representative of conditions between Niagara, New York, and Bellefonte, Pennsylvania. Included are 13 well sections from southern New York and northern Pennsylvania that are based upon detailed examination of well cuttings. That the beds thicken southward is emphasized. The apparent limits of the Oriskany sand in New York, Pennsylvania and Ohio are indicated and the probable distribution of other deep horizons is considered. Gas and oil possibilities of the Oriskany sand, the Salina group, the Lockport dolomite and the Medina group are discussed from the standpoint of the reservoir rock, structure and cementation and metamorphism, and the outlook for shallow sand production is considered. The paper is illustrated by 3 maps and 5 sets of columnar sections.

WHAT IS THE VAQUEROS FORMATION OF CALIFORNIA—OLIGOCENE?—Hubert G. Schenck, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 4, pp. 521–536.

The Vaqueros formation of the Coast Ranges of California has not been adequately defined as a stratigraphic unit and its early Miocene age is an assumption. Considering that Lyell (1833) specified a type locality for the Miocene, and believing that the Aquitanian stage of Europe should be taken as upper Oligocene, the writer expresses the opinion that the *Turritella inezana* zone, in whole or in part, may prove to be of Oligocene age.

ANTICLINES BETWEEN HIAWATHA GAS FIELD AND BAGGS, WYOMING.—W. H. Bradley, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 4, pp. 537–543. 2 figs.

Salt Lake City, Utah, and Rock Springs, Wyoming, receive a considerable part of their supply of natural gas from the Eocene Wasatch formation, in the Hiawatha gas field, which spans the Wyoming-Colorado boundary line south of Rock Springs. Supplemental supplies of gas may be expected from a series of small anticlines that extend eastward from the Hiawatha field to the town of Baggs, Wyoming. Five of these anticlines are described here. The stratigraphy and regional structure are discussed briefly, and the accompanying map shows the areal geology and structural relations of the folds and faults.

AGE AND CORRELATION OF PENNSYLVANIAN SURFACE FORMATIONS AND OF OIL AND GAS SANDS OF MUSKOGEE CO., OKLAHOMA.—Chas. W. Wilson, Jr., in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 4, pp. 503–520. 4 figs.

The Pennsylvanian formations of southeastern Oklahoma are correlated with those of northeastern Oklahoma. The Atoka, Hartshorne, McAlester, and Savanna formations and a portion of the Boggy shale—all of lower Pennsylvanian age—are directly traceable into the Winslow formation as heretofore mapped in the Muskogee Quadrangle. The upper sandstone member of the Savanna sandstone is equivalent to the Bluejacket sandstone member of the Cherokee shale on the north side of Arkansas River and is herein designated as the Bluejacket sandstone member of the Savanna sandstone. The outcrop equivalents of the oil and gas sands of western Muskogee County have been recognized.

GRETA OIL FIELD, REFUGIO CO., TEXAS.—R. A. Stamey, J. C. Montgomery and H. D. Easton, Jr., in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 4, pp. 544–559. 7 figs.

Greta oil field, in the north-central part of Refugio County, was discovered by George E. Smith *et al.*, May 5, 1933. The field is in the shape of an irregular elongate oval measuring approximately 4 by 2.5 miles with its major axis extending N. 22.5° E. The structure is almost flat on top with steep dips in the beds beginning at the periphery and extending in northeasterly, southeasterly, and southwesterly directions. There is the suggestion of a fault along the northwest side of the field. The three pay horizons are the Catahoula, or 3,500-foot sand, the *Heterostegina*, or 4,400-foot ("Greta") sand, and the Frio, or 5,900-foot sand. At the end of 1934 there had been completed 186 oil wells with a total cumulative production of more than 5,000,000 bbl.

Drilling

DRILL STEM.—H. W. Fletcher, before Am. Petr. Inst., Tulsa meeting, 1935.

In the light of past experience with drill stem, it would seem that we must look to a reduction in the parasitic weight of the tool joints to reduce fatigue failures in the pipe, although it seems inevitable that this must result in some reduction in the strength of the joint itself. It is possible that in time the use of light-drilling weight and high-rotative speed may become so general that we can safely reduce the torque-carrying ability of the joint to a sufficient degree to accomplish a noticeable reduction in weight—although there is then the hazard that when the pipe is wound up against a stuck bit, serious tool-joint damage may result throughout the string.

Some improvement can probably be secured through a change in design at the point of attachment of the tool joint to the pipe. A number of experimental strings are now under test in which the pipe thread is either eliminated or so changed in form as further to reduce stress concentration due to the notch effect of the threads, or in which additional sealing and reinforcing means are provided to reduce stress and prevent corrosion attack at this vital point. It is still too soon to state definitely that any of these constructions will "solve the problem"—although there is some

indication that a degree of improvement has been accomplished.

The present high cost of fully corrosion-resistant materials is the principal bar to their use to combat corrosion-fatigue failures in those districts where that type of failure is troublesome. Some improvement can be expected from the use of intermediate alloys, there being already a few strings of low-chrome nickel in service. It seems likely that, as price permits, the metallurgical trend will be in that direction.

The ultimate development of pin-and-box design is difficult of prediction. In no other large-scale mechanical application is a connection of this type used to transmit torsion, flexure and tension, or compression. It seems that the shouldered taper-thread connection best meets all the requirements of this job, and that such improvement as is attained will result from minor refinements in thread form and to a greater degree from more careful handling in service.

Control of Drilling Mud in Deep Wells.—George L. Ratcliffe, in WORLD PETROLEUM, vol. 6 (1935), No. 4, pp. 240–243.

The principles of the use of drilling fluids are outlined. Muds of low weight, with low viscosity and rapid gel-forming abilities are preferable. Perhaps the most important item in the drilling of deep wells is careful and continuous checking and control of the properties of the mud by a competent man assigned to that job.

Cementing the World's Deepest Casing.—C. P. Parsons, in WORLD PETROLEUM, vol. 6 (1935), No. 4, pp. 220–222.

The first string of casing to be run and cemented below 10,000 feet was in the McElroy No. 103 10,300 ft. well of the Gulf Production Co. in West Texas. The incidents attending this feat are graphically described.

Chitorani No. 1, Roumania's Deepest Well.—Ovid. Vesp. Erbiceanu, in WORLD PETROLEUM, vol. 6 (1935), No. 4, pp. 215–219.

An illustrated account of the drilling of the deepest well in Roumania, which was sunk to a depth of 11,092 feet at an approximate cost of $100,000. The difficulties encountered and equipment used are described. This well was a wildcat, and was undertaken to see whether the Meotian sands were productive at this location, which did not prove to be the case. A similar well is to be drilled on the northern flank of the same anticline.

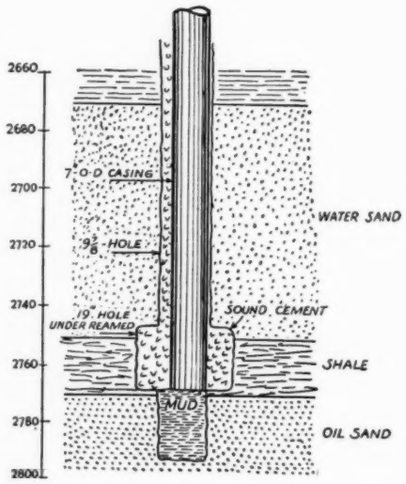
The Development of Rotary Drill Pipe.—H. W. Graham, before Am. Petrol. Inst., Tulsa meeting (1935).

The first form of rotary drill pipe was welded merchant pipe, but early in the use of this system merchant pipe was replaced by seamless tubes. The introduction of seamless tubes was followed in rapid steps by increasing carbon content and tensile strength, concurrent with interior upsetting. Upsetting introduced weaknesses which can be eliminated by full-length normalizing of the drill-pipe tube. The threaded connection of drill pipe to tool joint is responsible for many failures, in that the thread acts as a notch in the root of which a crack progressively deepens under conditions of corrosive fatigue. This type of failure can be overcome by eliminating the threaded connection by forging an upset on the drill pipe to act as a tool joint.

Cementing Methods for Excluding Water from Producing Wells.—R. E. Watson, before Am. Petr. Inst., Tulsa meeting, 1935.

This paper is presented as a supplement to previous papers in order to cover recent developments along the lines of oil-well cementing.

Three cementing methods have been developed and utilized successfully for plugging off water.



Diagrammatic Sketch Showing Under-reaming and Cementing of Casing to Exclude Upper Water.

One method consists of plugging off bottom water in producing wells by means of an especially-designed tubing plug and placing the cement under pressure.

The second method pertains to under-reaming and cementing of oil-string casing to shut off water occurring only a few feet above the oil-producing horizon. (See illustration.)

The third method is a refinement of the old "squeeze" job, and requires, first, ascertaining the pressure necessary to pump water into the formation being cemented, followed by the proper cement slurry under pressure.

Determining How Much of a Frozen or Cemented Column of Pipe is Free.—J. T. Hayward, before Am. Petr. Inst., Tulsa meeting, 1935.

Drill pipe and casing sometimes accidentally become stuck in the hole. Some method of finding out where the pipe is frozen is then desirable, so that decisions can be made as to whether to make further efforts to free it, or to cut or shoot it off and side track. In the latter case what we require to know is how much is frozen so that a shot can be properly placed, or the knife run a minimum number of times and yet recover as much as possible. The object of the present paper is to outline methods for determining where the pipe is stuck, or conversely how much is free.

There is another direction in which this information may be useful. It is becoming of increasing importance, when casing is cemented, to know how far up the column is actually cemented. There are, for instance, occasions when it is important that the cement should not come up beyond a certain height and cover an upper show that could be later exploited by cutting and pulling the pipe or perforating with the gun. At other times, it is wished to bring the cement above a certain level, so that water may be shut off from oil sands behind the pipe, and the latter later produced through perforations.

The author outlines three different methods and explains their principles. The first depends upon the weight indicator, the underlying principle being to change the longitudinal stress in the column while measuring the change in stretch, the free length of the pipe being calculated from this data. The second method involves a measurement of the strain produced in a length of the pipe (above ground) by a certain pull in comparison with the strain produced in the frozen pipe in the well; this also gives data from which the unfrozen length can be calculated. The third method is similar to the second, with the difference that torsions are applied instead of pulls.

Oil Well Operation

Safety of Water-Flooding Pressures at Bradford, Pa.—Frederick G. Clapp in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 6, pp. 793–852.

The properties involved in the problem reviewed are located in the Bradford field, McKean County, Pennsylvania. A large number of wells were abandoned during early years of development, but operations have been revived by the Petroleum Reclamation Company, which is reclaiming the field by the water-flooding process. The system used is locally known as the "five-spot" process, by means of which water under abnormal pressure is forced down intake wells at all corners of a square and the crude is recovered in due course from an oil well at the center. Since the entire production area is covered with a pattern of such wells, it is evident that the "pay" zones in the Bradford sand become saturated with water at increasingly high abnormal pressures varying in accordance with the intake pressures.

The question placed before the writer in the summer of 1932 was whether any danger might ensue from loss of oil or destruction of strata or properties owing to excessive pressures transmitted against the roof of the sand by means of intake flooding. Some of the criteria considered were earthquakes, gas and volcanic blow-outs, surface subsidence, salt-dome mechanics, hydrostatic conditions in known aquifers, formulas for the strength of materials, etc. The answer at that time, after approaching the problem in various ways, was that no danger would result up to an intake pressure of about 3,000 pounds per square inch and probably much higher. The supporting data are interesting and extensive.

Determination of Oil Content of Sands for Water Flooding.—W. L. Horner, in PETR. ENG., vol. 6 (1935), No. 7, pp. 33–35.

The question of how much oil is retained in a petroleum reservoir has always been of interest to producers. This question has often been answered by a solemn guess, or by some equally inadequate approximation based on the production history of the depleted field, assisted by an occasional determination of the porosity of the producing horizon. These methods of estimating the amount of oil that producing methods have failed to reduce to possession are unsatisfactory for water-flooding, and cores of the sand are usually obtained for appraisal purposes. The cores can be tested in the laboratory and the results usually are of assistance in repressuring operations, furnishing definite knowledge of the amount of oil remaining in the oil-bearing formations.

Various methods for testing cores of reservoir sand for saturation and oil content have been developed, and after experience with a number of these methods the author prefers the retort method, which is to place the core in an iron retort (made from a mercury flask) and distilled at a red heat until products of distillation cease to come over. A correction is applied for a constant percentage of oil lost as vapor and coke, and the volume of oil recovered is calculated back on the volume of the rock, from which may be deduced the bbls. of oil per acre-foot of the sand. This method is now used on all cores taken in the Bradford field by consultants and oil companies.

Evolution in Pumping Practice.—W. G. Taylor, in WORLD PETROLEUM, vol. 6 (1935), No. 4, pp. 236–239.

The trend of pumping practice from the old "standard" pumping rig to modern money-saving electrical pumping outfits is reviewed.

Economic Significance of the 10,000-ft. Well.—John F. Dodge in WORLD PETROLEUM, vol. 6 (1935), No. 4, pp. 202–205.

From the study here presented it results that while it is possible to sink an oil well to and beyond 10,000 ft. the economic results will be contingent on the quantity of oil found and how much of this oil comes to the surface otherwise than by pumping. With a 10,000-ft. hole costing around $300,000 and with oil at $1.00 a barrel, the well must be good for at least 600,000 bbl. during its flowing life if the operator is to cover all expenses and make a profit. When the level of the oil in the well has sunk below 7,500 feet, neither pumps nor straight gas lift will recover it profitably with present equipment; intermittent gas lifts, electrically operated deep well pumps and hydraulic plunger pumps are a little better, but not much. In general, until new equipment and technique are developed, 8,000 feet seems to be about the limit to profitable oil recovery. A statistical record of the world's 13 deepest wells is given.

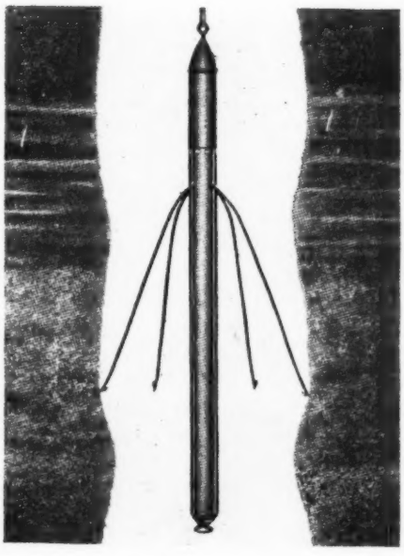
Problems in Exploitation of Deep Deposits.—Lester C. Uren, in WORLD PETROLEUM, vol. 6 (1935), No. 4, pp. 208–214.

This is a very readable summary of the varied and in many cases enormously difficult physical problems involved in the sinking of the modern oil well. The great weight of long strings of casings and drill pipe, and high pressure of drilling muds are such as to tax the ingenuity of the petroleum engineer and the resourcefulness of equipment manufacturers.

It is usually considered a fortunate circumstance that the high pressure gas in deep-seated reservoir rocks tends to flow a greater percentage of the oil of a deep well than of a well producing from a shallower formation. The producer welcomes this, and tries to keep the well flowing, but the author warns that instead of using formational energy to lift the oil it will be more important to conserve it for the duty of forcing additional oil out of the reservoir into the well by lifting the oil in the well by artificially developed energy. It is the ultimate recovery that repays the great cost of deep drilling.

Open-Hole Recording Calipers.—R. C. Beckstrom in OIL WEEKLY, vol. 77 (1935), No. 11, pp. 19–20.

Irregularities and cavities in open holes are automatically measured and recorded by means of an instrument shown in the accompanying illustration. The apparatus consists of a 5-in. pipe which encloses a recording mechanism that receives impressions from four arms that make sliding contact with the walls of the hole.



The arms operate a ratchet which raises and lowers the recording stylus against a chart in the cylinder. Each arm registers its own radius. By this means it is possible to determine the extent and position of the cavity. A ball bearing swivel prevents the instrument from spinning in the hole as each arm is held against the side of the walls of the hole by strong springs. This keeps the calipers oriented as it is raised in the hole.

The calipers are raised and lowered by a wire line, which passes through a measuring device giving the exact depth of all the readings on the chart. The recording mechanism is driven by a clock which moves the chart at a uniform speed. The instrument is raised at a known speed and stopped at stated intervals so that the record on the chart may be recorded in terms of diameters at known depths.

The information obtained is useful in measuring the extent of caving due to solvent action of water on salt formations or by action of acid in enlarging the hole, to check the effectiveness of methods for controlling heaving shale, and to show favorable locations for setting casing or packers; also to compute the amount of cement needed.

Asphalt and Tar

International Bitumen Trade of 1932 and 1933.—Walther Schmidt in PETROLEUM ZTSCHR., vol. 31 (1935), No. 11, pp. 9–16.

In this extensive annual survey of international trade and production of bitumens and natural asphalt the statistics, gathered from named sources, are brought down to September 1, 1934. The figures for bitumen production are given in the following table.

Production of Bitumen, 1930 to 1933 in 1,000 Tons

	1930 1000 t.	1931 1000 t.	1932 1000 t.	1933 1000 t.	%
United States	3853	3515	3282	3019	65.6
Mexico	218	170	140	150	3.3
Canada	149	125	91	18	2.1
Other America	10	40	37	43	1.0
America	4230	3850	3550	3310	72.0
Great Britain	364	596	383	345	11.8
Germany	275	258	266	336	7.1
France	46	69	123	167	3.6
Netherlands	118	88	47	43	1.0
Russia	34	43	43	43	1.0
Roumania	24	33	39	41	0.9
Poland	18	22	19	22	0.5
Italy	15	11	12	15	0.3
Other Europe	6	5	4	8	0.3
Europe	900	1125	935	1220	26.5
Africa and Asia	70	50	65	70	1.5
Whole World	5200	5025	4550	4600	100

Most of the export bitumen goes to Europe, where production is only about one-third of the annual requirement. The United States, Trinidad and Italy continue as the chief producers of natural asphalt.

Physical Properties of Asphaltic Mixtures at Low Temperatures.—L. F. Rader, before Am. Soc. Testing Materials, Detroit meeting, 1935.

Although a great deal of attention has been given to the determination of the physical properties of asphaltic mixtures at normal and at elevated temperatures, particularly to the determination of stability, little work has been done on the physical properties of asphaltic mixtures at low temperatures. Quantitative data are available concerning the ability of asphalt paving mixtures to resist displacement, and methods of proportioning and selecting materials have been established, by means of stability tests, to overcome failure in service due to shoving, waving, and rutting. It is believed that these data need to be supplemented by the results of tests at low temperatures. Quantitative data obtained from low-temperature tests should aid engineers in solving problems relating to the control of cracking.

This paper describes equipment and methods of test developed for determining modulus of rupture, modulus of elasticity in flexure, and toughness of asphaltic mixtures chilled to low temperatures. Modulus of rupture and modu-

lus of elasticity in flexure are determined by testing a chilled beam of compressed asphaltic mixture on a 6-in. span. The toughness test is conducted by testing a chilled briquet in the standard Page impact machine. The specimens are chilled by using solid carbon dioxide as the refrigerant.

The test results show the influence upon physical properties of asphaltic mixtures at low temperatures of the following variables: (1) chilling temperature, (2) compaction of mixture, (3) percentage of asphalt, (4) asphalt of different origins, methods of manufacture, penetrations, and susceptibility characteristics. The stability at 140° F. of each mixture is given.

Among the conclusions it is pointed out that (*a*) sheet asphalt mixtures chilled to low temperatures are brittle materials having definite load-deflection curves, (*b*) the mixtures become stiffer and more brittle with decrease in temperature, (*c*) compaction is important to develop tensile strength at low temperatures, (*d*) the use of low normal penetration bitumen tends to make mixtures stiff and brittle at low temperatures, and (*e*) advantageous use of low-temperature physical tests of mixtures may be made in designing asphaltic mixtures.

Modification of Miscibility Test for Asphalts.—C. A. Downing, before Am. Soc. Testing Materials, Detroit meeting, 1935.

Expensive delay and inconvenience is often experienced by both consumers and producers of asphalt emulsions on account of being forced to wait fo the release of materials due to certain specified tests. A method has been devised that will predict for all practical purposes the probable 5-day settlement results. This method is based on utilization of the original conception of the miscibility test, that is, extreme dilution of mixing emulsions in the ratio of 50 ml. of emulsion to 150 ml. of distilled water serves as an accelerated stability test. The apparatus used is simple and inexpensive; and the method suggested is one that can be carried on in conjunction with present routine tests. It has the advantage that a complete release on the material in question may be made within one day after the sample is received in the testing laboratory.

The tabulated data cover a wide range of different type mixing emulsions produced by six different producers that merchandise emulsions on a national basis. The data cover materials produced in nine different plants and include emulsions that were prepared from both Mexican and domestic asphalts.

Natural Gas

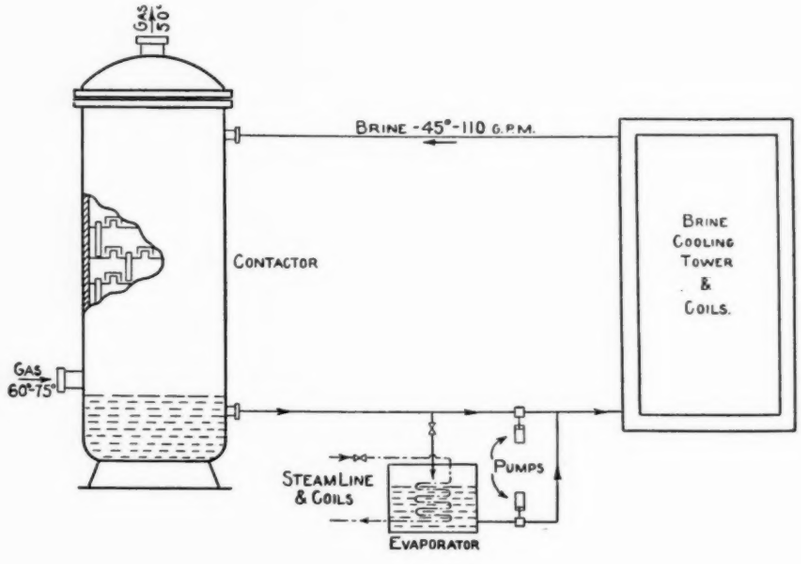
Natural-Gas Possibilities East of the Main Fields of the Appalachian Region. Olive C. Postley, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 6, pp. 853–875.

Since the discovery, during the past several years, of productive gas fields in south-central New York and northern Pennsylvania, interest has been aroused in prospecting for gas in this general region. This commodity is not subject to overproduction in the eastern Appalachian and adjacent regions where adequate market facilities are available. A belt of country immediately east of the old developed oil and gas fields of the Appalachian region is believed to possess possibilities for the development of additional natural gas supplies. Gas in paying quantities has been found east of the 63 or 65 carbon-ratio line, which is usually regarded as the limit for the discovery of oil in commercial amounts. Carbon-ratio lines for this eastern belt are shown on a map which has been prepared by using available coal analyses published by the United States Bureau of Mines.

Dehydration of High Pressure Natural Gas.—Arthur B. Allyne, before Am. Gas Assoc., Nat. Gas Dept., Memphis, May, 1935.

The advantages of dehydrating high pressure natural gas are summed up as follows:

1. Prevents internal corrosion.
2. Reduces pressure drops in line and therefore increases capacity, by (a) Prevention of actual clogging of line with water, (b) Prevention of roughening of pipe interior by corrosion products, and (c) Elimination of freeze-ups of water or hydrates.
3. Does away with drippage removal and drip maintenance.
4. Reduces number of shut-downs, leaking and ruptured lines, and potential lawsuits.
5. Prevents serious dust problems in distribution systems due to travel of corrosion products.



This excellent paper is an impartial discussion of various means of dehydration. Up to the present, two general methods have been employed. In one, atmospheric cooling or artificial refrigeration is employed to condense the water from the gas, while the other method depends upon the absorption or adsorption of water from the gas. The cooling method has an advantage of simplicity, but requires rather extensive installations. A plant for absorption or adsorption is more compact, but requires facilities for reconcentrating or reactivating the drying agent. A typical example of dehydration by atmospheric cooling is the plant of the So. Calif. Gas Co. at Kettleman Hills, which is described in detail. A dehydrating plant employing ammonia refrigeration is the installation of the Industrial Fuel Co., Ventura, Calif.; propane as a refrigerant is used by the Natural Gas Pipeline Co., which operates between Fritch, Tex., and Chicago. A serious drawback of refrigerating methods is the formation of hydrates in the plants themselves, resulting in freeze-ups causing as much trouble as the line stoppages previous to dehydration.

Although activated alumina, anhydrous calcium sulphate and silica gel have been proposed as solid dehydrating agents on the adsorption or absorption principles, none have been used to date. However, the Southern Counties Gas Co. of Los Angeles has completed satisfactory experimental work on a plant for dehumidifying gas by means of silica gel. A flow diagram of this plant is given.

Among hygroscopic liquids that might come into consideration as dehumidifiers of high pressure natural gas, only calcium chloride solution seems to have come into practical use; this is at the plant of the Montana Power Co., Cut Bank, Mont., where climatic conditions are severe. The flow diagram of this plant is shown in the accompanying drawing. The concentrated calcium chloride brine is precooled to a low temperature and passed down a bubble cap absorption tower against the rising gas. The strength of the brine is maintained by passing a small part of it through a steam coil evaporator. The paper closes with interesting suggestions for further study in this important field.

Pipe Lines

Use of High Speed Diesel Engines on Pipe Lines.—J. B. Horshman, before Am. Soc. Testing Materials, Tulsa meeting, 1935.

During the past two years some high speed

Diesel engines have been tried out in the pipe line industry. It was believed at first that this type of unit would find extensive use in field gathering stations on account of low weight, small first cost, portability, and a wide range of speed variation to meet varying capacities. These requirements have been fulfilled, but there remains the disadvantage that a special fuel is required for satisfactory operation. Corrosion of the fuel injection system has been serious in some cases and in others there has been difficulty in burning heavy oils at high speeds. The solution of the high speed Diesel problem, so far as it relates to pipe line pumping in isolated fields, lies in the use of metals or materials that will resist corrosion, and improvement of the combustion chambers so that the heavy oils can be burned.

Petroleum Chemistry

A STANDARDIZED TEST OF GASOLINE COLOR STABILITY.—C. D. Lowry, Jr., M. A. Smith and Geo. B. Murphy, in IND. ENG. CHEM., analyt. ed., vol. 7 (1935), No. 3, pp. 140–143.

Although most gasoline now sold is dyed, much is still marketed water-white. Such gasoline may be colorless or nearly so when delivered to the filling station, but becomes strongly colored when exposed to strong light, as in pumps with visible bowls. For this reason gasoline is often subjected to a test for color stability, for which purpose the authors, working in the laboratories of the Universal Oil Products Co. have devised a standardized test. The apparatus used is a flame-type carbon arc (C 3A of the National Carbon Co.), 60 amp. 50 v. with two pairs of carbons that burn alternately. The gasoline to be tested is exposed in bottles to the light of this lamp and the color is read at intervals of five minutes. The results are compared with the color drop of the gasoline when exposed in a similar bottle to the noon-day sun; in the latitude of Chicago 40 minutes exposure to the arc light is equivalent to two hours exposure to brightest summer sun; by using quartz bottles 15 minutes will suffice for making a test. The described procedure has been used for three years and has proved rapid and reproducible.

ANALYTICAL SOLVENT FRACTIONATION OF LUBRICATING OIL.—Ulric B. Bray, Ralph C. Pollock and David R. Merrill, before Am. Petrol. Inst., Tulsa meeting (1935).

By suitable choice of conditions in solvent extraction by the multiple-batch method, an analytical procedure has been developed for solvent fractionation of oils in the lubricating-oil range. This procedure makes it possible to separate an oil into a series of cuts of varying paraffinicity. The results, conveniently shown as composition curves, permit close estimation of possible yields of oil of specified quality or give valuable information on the composition of finished motor oils.

Examination of various stocks has shown that the differences between them are much more in the relative proportion of the different constituents present than in the constituents themselves. By the analytical fractionation procedure developed, it is possible to determine whether any particular stock contains a sufficient proportion of oil of specified quality to make production of such oil economically feasible.

Solvent fractionation of finished motor oils shows the extent to which the low-grade components have been eliminated in the refining operations. Data on a large number of typical motor oils show a wide variation in this respect, but the absence of the low-grade low-API-gravity constituents in highly-refined solvent-extracted oils is very noticeable. Because of the adverse effects of such constituents on quality, the analytical results are valuable in predicting the performance to be expected in service.

COLD TEST FOR FUEL OIL.—B. H. Moerbeek and A. C. Van Beest, in J. INST. PETRO. TECHNOLOGISTS, vol. 21 (1935), No. 137, pp. 155–168.

Objections are raised to the present methods of pour-point determination as applied to fuel oils, especially by A.S.T.M. method. The authors are convinced that the difficulty is due to the presence of asphaltenes in most residual oils; these asphaltenes influence the mode of crystallization of the paraffin wax, an influence which differs with the temperature of pretreatment. The method they propose as a substitute is first to cool the oil to 0° C., heat again to 35° C., from which temperature the oil is gradually cooled under a pressure of 20 cm. of mercury to make the cold test. The principle of this modified test is that the asphaltenes are separated on the wax crystals by the first cooling; the subsequent reheating dissolves the wax but not the asphaltenes, so that on the second cooling the asphaltenes do not prevent the formation of a cohesive crystal structure in the fuel oil.

Petroleum Physics

USE OF PHYSICAL CONSTANTS FOR DETERMINING THE COMPOSITION OF MOTOR FUELS.—M. Marder in OEL UND KOHLE, vol. 11 (1935), Nos. 1, 3, 5, 7, 9, 11, 13.

At the present time, the means chiefly relied on for evaluating the "power value" of a motor fuel is an engine test carried out under strictly prescribed conditions with an engine of exactly specified construction. The matter of determining energy value and anti-knock quality of a fuel is thus taken out of the hands of the oil chemist, although it is precisely the chemical composition of a petroleum product that determines its qualities.

In this extensive and interesting paper the author shows a way for obtaining a deeper insight into the composition of a hydrocarbon mixture than has heretofore been possible. The methods depend on the use and interpretation of the physical constants of mixtures of the lighter petroleum fuels (application of the methods to heavier fractions awaits further investigation). From the gravity and the refractive index of the fuel before and after removal of the aromatics through the use of sulphuric acid it is possible to estimate the aromatic content with great exactness. If it can be assumed that the naphthenic portion consists only of cyclohexanes, the approximate content of naphthenes and paraffin hydrocarbons can be ascertained by these constants.

Better results are obtainable through the use of combined physical constants. Among these is a composite value, called the parachor, a physical constant not heretofore used in mineral oil chemistry. This constant combines the surface tension and the gravity and brings out characteristic differences among classes of hydrocarbons. If the parachor of a motor fuel is determined before and after removal of a particular hydrocarbon group, the parachor of this group can be calculated and conclusions drawn as to the inner constitution of this group. By this means the average number of double bonds per molecule of the unsaturated compounds can be determined, also the degree of hydrogenation of the aromatics of the lower fractions, and the average number of rings per molecule of the higher fractions of the aromatics. It is also possible to ascertain the average number of side chains of the paraffin hydrocarbons, and the average number of carbon atoms of the naphthene rings. The method can be applied to other physical constants. A series of investigations has shown that the scope of the method is limited only by the ability of the chemist to make the necessary chemical separations.

The specific refraction is also useful in hydrocarbon analysis. Merely a knowledge of the refraction and the molecular weight or boiling range of aromatic-free gasoline is sufficient for a calculation of the proportions of paraffins and naphthenes. Examples are given to show that the refractometric method is more accurate than the aniline-point method heretofore used. The paper is extensively documented.

THE TENSIMETRY OF HYDROCARBONS.—E. L. Lederer, in PETROLEUM, vol. 31 (1935), No. 16, pp. 3–8.

The author calls attention to a little known experimental method of determining the vapor pressure of hydrocarbons and to the possibility of calculating the flash and fire points from the vapor pressure. The method depends on the fact that when through a liquid there is bubbled a gas that does not react with the liquid and is not soluble therein, the amount of vapor taken up from the liquid by the gas at a given temperature is the same as would be found at the same temperature in a vacuum in the same volume. At low temperatures, where oxidation is not to be expected, air may be used; at somewhat higher temperatures nitrogen or carbon dioxide may be employed; for temperatures above 100° C. superheated hydrogen is recommended. The method consists in leading a known volume of the gas through the oil and noting the loss of weight. The molecular weight must be known or measured by some of the known methods. It will be sufficient for the purpose to determine the boiling point and from this determine the molecular weight by a graphical method given by the author.

ABSOLUTE COLOR-VALUES OF MINERAL OILS.—Rudolph Koetschau, in OEL UND KOHLE, vol. 11 (1935), No. 21, pp. 351–361.

Instead of empirical measurements (such as with various forms of the Stammer instrument) the author recommends absolute measurements of oil color on the principle of the Lambert-Beer absorption law, making use of the Pulfrich photometer, which distinguishes the two independent properties of color strength and color type. In this way oils of different types may be recognized, and the effects of various treatments (clay filtration, etc.) determined. Various circumstances, such as copper test, aging tests, and the action

of selective solvents have characteristic effects on the color and can be registered by the photometer. This instrument is thus capable of becoming a valuable addition to the analytical equipment of the oil chemist.

Petroleum Refining

Cause of the Bleaching Action of Fullers Earth.—E. Erdheim and O. Schneider, in PETROLEUM, vol. 31 (1935), No. 16, pp. 1–3.

When fullers earths are used to decolorize oils a certain amount of coloring matter is absorbed by the clay particles. When the used clay is subsequently boiled with alcohol those clays having weak decolorizing power give up their absorbed substances and are restored to their original color. On the other hand the clays having strong decolorizing properties retain the absorbed coloring matter in this test and hence the used clay that has been boiled with alcohol has a permanently dark color, unless regenerated in a furnace. The conclusion is that there must be a chemical union between the strong clays and the coloring matters of the oil. Active carbons used for decolorizing oils give up very little coloring matter to alcohol, which is rather surprising because in this case it appears that color removal by carbons is purely an absorptive process and not a chemical reaction.

Fundamental Research on the Chemical Composition of Lubricating Oil—A. P. I. Research Project 6.—Frederick D. Rossini, before Am. Petrol. Inst., Tulsa, May, 1935.

Some of the available knowledge concerning the chemical constitution of petroleum is briefly reviewed. No definite, pure, individual hydrocarbon has ever been isolated from the lubricating-oil fraction of petroleum. The most effective means of separating the lubricating oil consists in the proper interlocking, combination, and variation of the physicochemical fractionating methods of distillation, crystallization, extraction, and adsorption.

The work of Institute Research Project 6 on lubricating oil, now in progress about 1½ years, is reviewed. The lubricating-oil fraction of a Mid Continent crude oil was dewaxed, extracted with sulphur dioxide, and treated with silica gel in order to obtain a stable "water-white" portion, which has been subjected to four stages of systematic distillation. When this oil has been thoroughly fractionated with respect to size of molecules, fractionations with respect to type will be made, with the aim of obtaining closely-fractionated cuts containing hydrocarbons of like size and type. When this stage of separation is reached, the way will be made clear for the ultimate separation of pure hydrocarbons.

Clay-treating a Million Bbl. of Gasoline with Same Earth.—R. H. Price and P. L. Brandt, in OIL AND GAS JOUR., vol. 33 (1935), No. 45, pp. 54–55; 58.

Typical clay-treating conditions have been compiled from a study of the operation of the 100-ton, four-tower, clay-treating installation, a part of the 32,000-bbl. combination unit of the Pan American Refining Corp., Texas City, Tex. Properties of more than 1,125,000 bbl. of gasoline treated by one clay charge in this installation have been correlated with clay life. Up to a clay life of 12,000 bbl. per ton (the end of the test period) the total gasoline produced from the unit had an initial color of 25 Saybolt, or better, and a copper-dish gum value of less than 15 mg. per 100 cc. The induction period of the sweetened total gasoline averaged over 400 minutes (Voorhees method) up to a clay life of approximately 4,000 bbl. per ton and at 12,000 bbl. per ton had dropped to an average between 340 and 350 minutes. The B.A.P. response on the total gasoline was very satisfactory, averaging 300 minutes per 0.001 percent B.A.P.

Relative Efficiencies of Packed Fractionating Columns.—P. Docksey and C. J. May, in J. INST. PETR. TECHNOLOGISTS, vol. 21 (1935), No. 137, pp. 176–199.

On the assumption that the rate of interchange of material between vapour and liquid in a fractionating column depends on the rate of diffusion through that part of the vapour in which the flow is streamline, it is possible to derive equations from which the relative efficiencies of columns packed with material of any given shape may be calculated. These equations apply both to the case in which the flow of the vapour is streamline, and to that in which it is turbulent, and allow the effect of alteration of pressure and vapour velocity and the introduction of diluent such as steam to be calculated.

Experiments on packed columns are described which were designed to check both the streamline flow and turbulent flow formulæ. The experimental results give good aggreement with the theory and indicate that the initial assumption is valid.

Reports on the Progress of Naphthology; 1934.—G. R. Nixon *et al.*, in J. INST. PETROL. TECHNOLOGISTS, vol. 21 (1935), No. 139, pp. 311–434.

This is an extended survey of the literature of petroleum refining that appeared in 1934. The subjects covered (each by a specialist) are: chemical and physical refining; theory of design of distillation equipment; cracking, progress in hydrogenation of petroleum and economic comparison with cracking; natural gas and natural gasoline; light distillates; kerosene and white spirits; lubricants and lubrication; gas oil, fuel oil, etc.; asphalts and road materials; special products; analysis and testing; engine tests of gasoline and Diesel fuel. There are 1376 literature and patent citations.

Polymer Gasoline from Cracked Gases.—V. N. Ipatieff and Gustav Egloff, before Am. Petr. Inst., Tulsa meeting, 1935.

Experiments are described concerning the polymerization of five samples of cracked gases in semi-commercial polymerization units. The operating conditions of gas rate, temperature, and pressure varied from 0.05 cu. ft. to 11.4 cu. ft. per hour per pound of catalyst, 450 deg. to 500 deg. F., and 100 to 175 lb. per sq. in., gage, pressure. The yields of liquid polymer ranged from 3.0 gal. to 8.4 gal. per 1,000 cu. ft., with olefin polymerizations of 71 to 99 percent.

The outstanding characteristic of polymer gasoline is its high octane number and blending value. Its distillation range can vary considerably without affecting its anti-knock qualities, and it has higher blending value than either benzene or *iso*octane—although its straight octane number is lower, 81 versus 97 and 100, respectively.

The oxygen-bomb stability of polymer gasoline is low, but its inhibitor susceptibility is high.

Oil Uses

Fuel Specifications for High-Speed Diesel Engines.—G. C. Wilson, before Am. Petr. Inst., Tulsa meeting, 1935.

The development of the high-speed Diesel engine depends as much upon proper fuel specifications as upon engine design. Therefore, refiners and engine builders will find it advantageous to cooperate in solving fuel problems.

The refiner has broad possibilities of taking a cracked distillate, or whatever may be left over from the refining of the more valuable products such as gasoline, and making it into a good Diesel fuel. It may require some chemical changes; and in order better to understand the fuel, it will require careful combustion studies. The difference between rough and smooth operation is a matter of what happens in the combustion chamber during the few thousandths of a second after the beginning of fuel injection.

Combustion in the Diesel engine is commonly considered as taking place in three states: First, a delay period—during which fuel is being injected, but no pressure rise occurs due to combustion. Second, the pressure rises rapidly out of control. The greater the delay period, the more severe will be the shock due to this rapid pressure rise. Third, the remainder of the fuel is injected and burned under control. Mr. Rose of the University of Wisconsin has developed an indicator which permits a detail study of these periods. He has found it possible to sub-divide the period of the first phase of combustion into two distinct periods, by determining the point at which combustion actually begins. One of the greatest needs at the present time is better correlation of laboratory information on Diesel fuels with service tests in the field.

Fuel Oil, Characteristics, Specifications, and Testing.—R. T. Goodwin, before Conference on Fuel Oil & Oil Burners, Madison, February, 1935.

Until a few years ago specifications on fuel oils were largely devised by refiners to suit the convenience of their refinery operations with little regard to the conditions under which the oils were to be used, but with some 350 different makes of oil burners, the necessity for specifications became apparent. The Underwriters' Laboratories allow six grades, but in the opinion of the author, who is manager of fuel oil sales for the Shell Corp., this is still too many, and for domestic use the No. 1 Grade can be used with success.

The slight differences in calculated heat values of different grades of fuel oil (as 40° A.P.I. and 36° A.P.I. fuel oils) are sometimes overestimated and have less relation to the overall thermal efficiency than the manner in which the oil is burned, and concerning which the public should be better instructed. Tests have shown that by allowing the oil to burn

with a smoky flame the boiler efficiency is soon reduced by a coating of soot. It is to the interest of the oil industry to see that the consumer is properly educated in the use of fuel oil.

Antiknock Effect of Tetraethyl Lead.—John M. Campbell, *et al.*, in IND. ENG. CHEM., vol. 27 (1935), No. 5, pp. 593–597.

The effectiveness of tetraethyl lead in increasing the critical compression ratio of 62 individual hydrocarbons was investigated in concentrations of one cc. per gallon. The general finding is that the action is little affected by variations in compression ratio for such hydrocarbons as alpha- and diolefines and acetylene compounds; in others there is considerable variation, while in certain unsaturated cyclic compounds, such as cyclopentadienes and certain aromatics with unsaturated side chains, lead has a "negative" effect, meaning that it acts as a knock inducer.

Tensile Strength and Density of Paraffin Wax at Various Temperatures.—W. F. Geyer and Kuramitsu Inouye, in IND. ENG. CHEM., vol. 27 (1935), No. 5, pp. 567–570.

The tensile or breaking strength of commercial paraffin wax was investigated at temperatures between −10° and 30° C. It varies considerably with the temperature, reaching a maximum value of 32 kg. per sq. cm. at about 3° C. The density was also measured over the same temperature interval. There appeared to be no direct linear relationships between the two quantities measured.

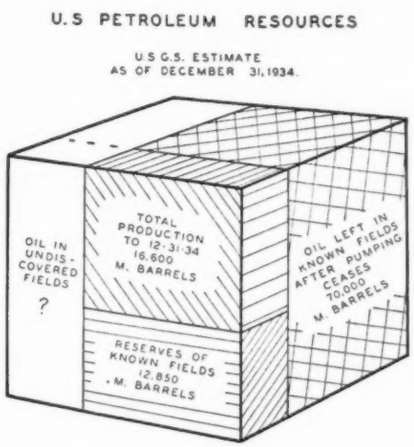
Effect of Volatility on Oil Consumption.—L. L. Davis and R. D. Best, before Am. Soc. Testing Materials, Detroit meeting, 1935.

The increasing use of the lighter S.A.E. grades, Nos. 10 and 20, of crankcase oils as compared to the heavier grades and the inherent greater consumption of the lighter grades makes it desirable to determine the factors controlling consumption. Previous work, in general, has indicated that viscosity is the major factor controlling consumption and that volatility is of little or no importance. The present work attempts to isolate the effects of volatility and viscosity. A series of S.A.E. No. 30 oils were prepared from the same crude having similar viscosity but widely different volatility characteristics. These oils were tested for relative consumption on a 4-cylinder engine-dynamometer assembly at speeds and temperature conditions similar to 40, 50 and 60 m.p.h. The results show a wide difference in consumption due to volatility. In the uniform series of oils tested, there appears to be a relationship between the consumption and the front end volatility as measured by the initial boiling point under 2 mm. absolute pressure. This relationship does not hold for oils of widely different viscosity-temperature characteristics, in which case the volatility effect is probably a function of the over-all distillation characteristics. The work indicates that volatility is a more important factor of consumption than has hitherto been thought. It is believed that, at least in the lighter grades of oil, volatility must be considered and that additional work is needed to study thoroughly the separate effects of volatility and viscosity on consumption of crankcase oils.

Petroleum Economics

Petroleum Reserves of the United States.—Wm. B. Heroy, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 5, pp. 717–725.

What are sometimes loosely referred to as petroleum "reserves" include supplies that (1) have up to now escaped discovery, (2) have not yet been extracted since the time of discovery, (3) that cannot be profitably extracted on account of low prices; the latter includes oil left in the ground after pumping has ceased. Aside from very small areas set aside by the government for the national defense there are no reserves in any strict sense of the term.



If the original oil content of the United States were represented by a cube of indefinite dimensions, as indicated in the accompanying figure, the relative proportions of total production to date, known reserves, and unrecovered residue in the ground will be as shown. The known resources of recoverable oil in the United States are now about 13 billion barrels; this may be increased by discovery of new pools, and (relatively) very slightly by improved methods of recovery. The increased difficulty of finding new pools makes the question of future supply more acute.

Motor Fuel Economics in Europe and the Possibilities of Development.—Hermann Suida, in PETROLEUM, vol. 31 (1935), No. 25, pp. 1–4.

One of the characteristics of the oil situation in Europe is the persistent attempt to tap sources of motor fuel other than petroleum, due to the general scarcity of oil deposits on the European continent. The search for petroleum substitutes is intensified by the programs of autarchy or self-sufficiency which are being forced on most European nations by the obstacles that have arisen in international exchanges. It also acquires strength from the fact that none of the great oil producing groups are of predominately European character; these concerns spread their interests over all the continents. Under these circumstances the development of substitutes will continue to an extent that depends on the general economic and political situations. The recent revival of the use of wood as a direct source of power for automotive vehicles may yet go far to relieve Europe from dependence on foreign oil. At any rate there is not now such a fear of possible blockades of oil supplies as there was 20 years ago.

Economics of Gasoline Volatility.—Hugh W. Field and Merrill J. Fowle, before Soc. Automotive Eng., White Sulphur Springs, 1935.

Due to a variety of causes there has lately been a definite trend toward the marketing of more volatile motor fuels. This paper discusses the refinery economic picture of gasoline volatility, since the cost to the automobile owner must ultimately be affected by the refiner's costs. At the present time there is a temporary excess of light natural gasolines, which permit the production of volatile fuels at a low price. But if this trend toward higher volatility is maintained the present excess of casing-head product will disappear, and the refiner will have to look to other sources of lighter components. The more important recourse will be to cracked gasoline. Here a shift to lighter motor fuel will increase costs up to 35 percent, in addition to requiring increased cracking capacity. Unless some unforeseen development occurs the motorist will ultimately have to pay more for whatever benefits he may obtain from the use of a very volatile gasoline.

World Oil Survey.—Anon. OIL WEEKLY, vol. 77 (1935), No. 1, pp. 29–200.

This is a survey of the world's crude oil reserves in areas outside the United States, consisting of tabulated data on development and production of about 675 oil and gas fields located in 40 different countries. The geographic position of each field is accurately described and discovery data are given; then follow an outline of the geological structure, particulars of the producing formations, extent of present development, deepest hole, productive area, production history, present activity and principal lease holders.

The Petroleum Industry of 1935.—J. Bennett Hill, in IND. ENG. CHEM., vol. 27 (1935), No. 5, pp. 519–524.

An interesting review is given of the present state of petroleum technology as of the current year.

As regards the future, the author feels that it is safe to say that the petroleum industry will always be influenced by the changing demands of the automotive industry, because whatever may have been the start of the industry, its principal business has become supplying fuels and lubricants for the internal-combustion engine. If, therefore, it is shown at some time in the future that engines can utilize sugar as a fuel more economically than gasoline it will become the job of the petroleum industry to make sugar. Just now the development of the Diesel engine with its specific fuel requirements is absorbing a great deal of attention.

Another prediction which it is safe to make is that development in the future will be along the line of complete utilization of crude petroleum by making every part of it a desirable and marketable product. A considerable part of the products from petroleum today have a market value lower than that of the crude. Research effort will certainly be directed toward rectifying this condition.

The basic need of the industry today for further radical advances is a better basis of fundamental research on the chemistry and physics of petroleum and its compounds.

Books

THE PRINCIPLES AND PRACTICE OF GEOPHYSICAL PROSPECTING. Being the Report of the Imperial Geophysical Experimental Survey. Edited by A. B. Broughton Edge and T. H. Laby. 372 pp., 8 pls., ills. Cambridge, at the University Press; New York, The Macmillan Company. $5.00

This survey was undertaken under the joint auspices of the British Empire Marketing Board and the Australian Government. Its object was not to prospect for minerals, but to test the applicability of various geophysical methods under field conditions in Australia where terrain conditions might be regarded as characteristic of considerable portions of the Empire.

The four principal methods, viz., the gravitational, seismic, magnetic and electrical, were applied to various economic problems and the results obtained together with particular conclusions in regard to each one are clearly set forth.

By far the greatest attention was given to the application of electrical methods in view of the fact that the other methods are well established and there exists a dearth of information regarding electrical and electromagnetic methods.

Besides the practical aspect of the report in presenting the applicability of the methods and instruments, the exposition of the principles underlying these four methods renders the volume exceedingly instructive and can well serve as a text.

LAW OF OIL AND GAS LEASES AND ROYALTIES.—Samuel H. Glassmire. Published 1935 by Thomas Law Book Company, St. Louis. 400 pp.

In this book the author covers a field not heretofore treated in recognized standard text books on the law of oil and gas, taking for his province the rights created by the mineral deed and by the oil and gas lease. The volume is divided into four parts. The first part is a general introduction to such facts relating to the oil industry and royalty business as seem pertinent to an understanding of the subject; the second part is a strictly legal treatment of estates in oil land and oil and gas leases; the third part treats of the basic law of oil leases and royalties as applied to standard leases and deeds, especially as construed by late decisions of the courts; the fourth part deals with miscellaneous topics and relationships about which there has existed much uncertainty and doubt. A large number of cases is cited and there is a good index.

EAST TEXAS OIL PARADE.—Harry Harter. 220 pp. The Naylor Company, San Antonio, Texas. 1934.

This brief but vivid work deals with the development of the East Texas field and with the romance, hopes and glamour of the colonizers, Juam Ximines and Stephen F. Austin. In 1925 and later in 1927, Columbus Marion Joiner, the wildcatter, with his host of faithful and hopeful investors, arrives in East Texas and begin their struggles to prove the field for production after many major companies had found little importance in the geological evidence. This part of the book reads like fiction. Just when their hopes and enthusiasm were at their lowest ebb, after three years of grim determination, all credit exhausted and the third well showing but little encouragement, oil—fortunes—spout from the ground. The parade marches on, the new oil town with its overnight growth and boom days of prosperity, fervid speculation and lease selling, intense drilling and the orgy of overproduction follow. The greed and politics of overproduction and the fruitless efforts of the Railroad Commission to curb the flow of oil and enforce proration likewise pass by. The rewards and riches of oil and the growing evidences of the decline of the field end the parade.

THE HANDBOOK OF BUTANE AND PROPANE GASES.—Second Edition 1935. 375 pp. Editor: George H. Finley, Western Business Papers, Inc., Los Angeles, Calif. $5.00.

The present edition involves many revisions and addition of material to the original handbook issued two yers ago. The marked activity in the production and distribution of liquefied petroleum gases, and recent research on liquefied fuels are recorded. As a result the second edition of the Handbook has a considerably broader range of subject matter. It comprises sixteen chapters contributed by outstanding technicians, dealing with the refinery processes, the increasing internal combustion engine use, competitive fuel data, central plant practice and application of these fuels to many newer uses.

The importance of these fuels in countries other than the United States and the intense development in the use of liquefied gases, imported and from local production, are reviewed. A directory, of central plants, complete bibliography of the literature, catalogue section and buyer's guide are appended. Numerous charts, illustrations and tables are included, making the handbook very comprehensive on this special subject.

APPLIED GEOPHYSICS IN THE SEARCH FOR MINERALS.—A. S. Eve and D. A. Keys. Cambridge: The University Press. New York: The Macmillan Company. 296 pp. $4.25. Second Edition.

This work is a very interestingly presented review of the theory and application of the five branches of geophysics as used in geological exploration, namely; magnetic, electrical, electro-magnetic, gravitational and seismic methods. Besides the practical discussion of the instruments and their use the authors have included sufficient mathematical explanation of the theory underlying the methods to interest both the lay individual and the specialist. The discussions include numerous typical illustrations and charts depicting the various anomalies as recorded from field observations, rendering the work exceedingly informative and instructive.

The torsion balance and seismic methods are treated in their application to petroleum exploration, inasmuch as these are particularly suitable for determining oil structures and have been successfully applied in the United States toward this end since their introduction.

Detailed mathematical demonstration on the derivation of important formulae is given in four appendices. Bibliographies on each of the methods of the leading articles and books are also included.

PRINCIPLES OF MOTOR FUEL PREPARATION AND APPLICATION.—Vol. I, by A. W. Nash and D. A. Howes. Published (1934) by Chapman and Hall, London. 538 pages. 30 shillings.

This is the first volume of a work that deals with the manufacture of automotive fuels from natural and synthetic petroleums. In view of the voluminous scattered literature on the subject the appearance of a treatise that gives a conspectus of established practices is to be welcomed.

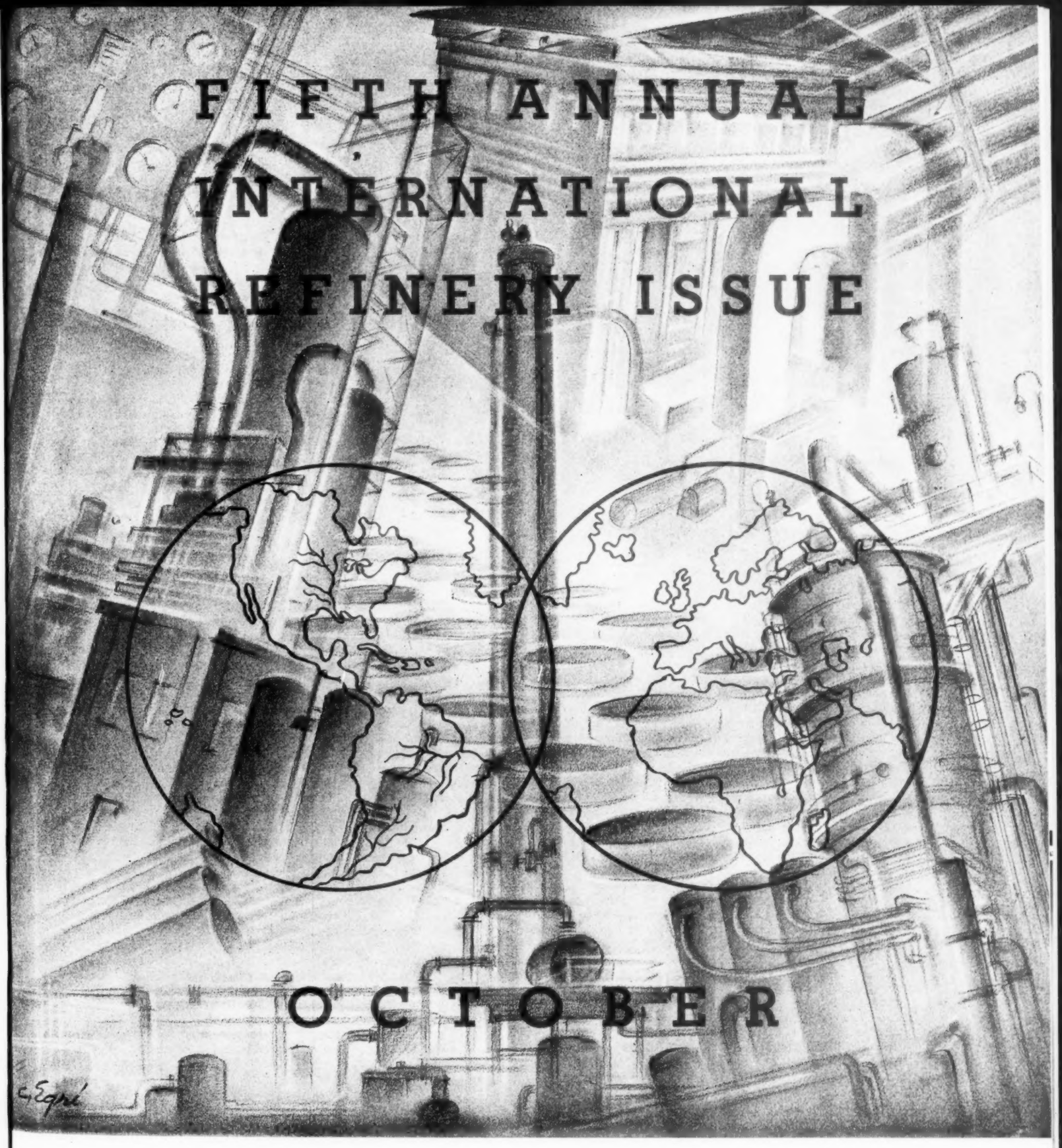
DIRECTIONS FOR THE USE OF THE ASKANIA TORSION BALANCE.—Prof. C. A. Heiland of Colorado School of Mines. Collaboration by prominent Geophysicists. 88 pp. $3.30. American Askania Corporation, Houston, Texas.

This work contains a summary of the entire field of torsion balance practice and a study of the theory leading up in an elementary manner to the well-known fundamental equation. Following this are instructions on how to calculate the gravity data from the instrumental records and how to compute various corrections. Numerous forms and graphs are shown to expedite computations in routine. Representation of corrected data, in form of maps and gradient-, curvature- and gravity-profiles is described, and methods of interpretation are discussed.

The book contains practical hints to the beginner and the more experienced observer as well, instructions for the most efficient operation of torsion balances and their application in the field.

OIL AND PETROLEUM YEAR BOOK, 1935.—Compiled by Walter E. Skinner, London. 352 pp. 7/6.

This 26th annual edition of the Skinner petroleum handbook gives concise particulars of 678 companies engaged in the oil industry throughout the world, including producers, marketers and oil financiers; there is also an extensive list of the directors, secretaries, agents, etc. of these companies. Noteworthy features are a list of trade names of petroleum products, and a glossary of technical terms of the oil industry. The usual statistical information is given regarding world oil production, and the monthly productions of the principal British companies. A list is also given of oil companies in liquidation or dissolution which may be useful in tracing obsolete oil securities.



World Petroleum will present in its October issue articles pertaining to every phase of the International Refinery situation—Economic—Engineering—Construction.

Present and projected building programs and the nationalistic legislation behind some of these; expansion of existing facilities to meet increasing consumption; improvements in and development of refining processes and equipment will be covered fully and will make this issue especially timely and significant.

WORLD PETROLEUM

NEW YORK LONDON LOS ANGELES SAN FRANCISCO

U. S. S. R.

Official Figures for Soviet Oil Operations

1935	Crude Production (bbl.)	Daily Average (bbl.)	Run to Stills (bbl.)	Drilling (Feet)
January	13,358,000	430,935	11,400,000	248,672
February	12,704,300	453,725	10,909,500	334,000
March	14,139,300	456,107	11,714,000	449,417
April	14,058,200	468,609	11,350,000	431,050
May	14,280,000	476,000	11,880,000	442,050
June	14,150,000	471,700	11,750,000	448,500
Total 6 Months 1935	82,689,900	457,950	69,003,500	2,353,689
Total 6 Months 1934	82,850,000	457,734	72,662,100	2,122,107
Total 1934	168,648,700	458,042	145,141,000	4,122,898
Quota 1934	214,900,000	588,876	161,000,000	4,950,000
Quota 1935	232,400,000*	636,700	171,500,000	5,214,000

* Including gas; Except gas 198,800,000 bbl. of crude
Crude conversion; seven bbl.=one ton

THE statistical record of the Soviet oil industry for the first six months of this year is decidedly unsatisfactory. Compared with the plan noticeable arrears are to be found in the three main divisions. With the exception of drilling both crude production and runs to stills show slight decreases against the corresponding figures for the same time of last year. Drilling for the six months past shows an increase of about 230,000 ft. over last year, but the plan has not been complied with and the quality of drilling as measured by the number of wells completed for operation is far from being satisfactory.

Production of crude except gas for all Soviet oil fields shows 41 percent fulfillment of the plan for the first half of the year and the corresponding figure including gas is 35.7 percent. Only Baku shows an increase which amounts to six percent above the corresponding figure of production last year. The value of this increase was neutralized by arrears in all other Soviet oil fields. Even at Baku production has dropped during June from a daily average of 389,040 bbl. at the beginning of the month to 378,200 bbl. per day during the last 10 days. The operation of practically all new oil wells is unsatisfactory and serious irregularities have become quite frequent at wells under compressor operation in most major oil fields of Baku such as the Stalin, Kaganovitch, Molotoff, Asisbekoff groups etc. The total arrears of Baku crude production for the six months aggregates over 8,000,000 bbl. of crude. These arrears have accumulated since the beginning of the year and have been gradually increasing. The month of June which is usually ideal for field operations has not carried any improvements; on the contrary. Of 285 rotary outfits in operation at Baku only 265 units were operated during June and of the 48 wells drilling which were expected to be completed in June less than 50 percent were brought to completion. The number of new wells sunk during the month shows only 44 percent of plan fulfillment owing to high numbers of breakdowns. Forty-five breakdowns at wells were registered at Baku during the first 10 days of June.

A total of 154,000 bbl. of crude is to be produced from the Baku oil fields during 1935. About 64,000 bbl. of crude were lifted at Baku during the first six months and there is no doubt that the authorities at Moscow and the regional Azerbaidzan Communist party functionaries will shortly take the necessary steps to stimulate activity more in line with requirements.

The Grozni oil fields have incurred arrears of 2,500,000 bbl. of crude although the drilling reports from Grozni reflect more or less favorably upon the statistical showings for the six months past. The speed of drilling has been improved from about 645 ft. per month in 1934 to about 925 ft. in 1935 (460 feet in 1933). However, the number of new wells brought into operation continues to be exceedingly low.

Prospecting of new regions at Grozni shows poor results. Fifty-four new wells were spudded in during 1934: Of these, 14 wells were completely abandoned as unfavorable locations and of the remaining 40 wells only 10 were completed with four wells producing and the others dry holes.

Following the example of Baku all refineries were organized as an independent unit under "Grozneftzavodi" for which the English equivalent is "Grozneft Refinery Trust" and Mr. Nuremberg has been appointed chief engineer and vice chairman.

With the exception of some reconstruction of the old refineries the Soviet refining facilities have practically remained unchanged during the last year or so. Winkler Koch units were not modified and Alco, Foster Wheeler and Badger units were neither reconstructed nor enlarged. Therefore, the increase in Soviet refinery output was attained at the expense of more or less perfected methods. On the other hand this may indicate overtaxing the capacity of the refineries by longer cycles of operation, working overtime and insufficient respite for cleaning, repairs etc. for which the price will be paid at a later date. At any rate refinery operations were increased and mostly at Baku for which S. B. Slutzki, head of the Baku Refining Trust was decorated recently with the order of Linin, which is the highest Soviet symbol of merit.

Among the various difficulties under which the Soviet oil industry is laboring to meet the plan, labor difficulty is an outstanding factor hindering progress. The major Soviet oil fields, of course, have at disposal sufficient drillers, brake hands, roughnecks and so on but there is a distinct shortage of team leaders as well as of common help and the auxiliary enterprises are likewise affected by shortages of either operators on commanding jobs or common help. Migration of labor in Soviet oil fields has assumed enormous proportions. This is not unusual at this time of the year when all sorts of farm hands who have found employment in the oil fields during the winter and spring months are anxious to return to farms but why should regular labor be anxious to change employment so often? This is largely due to frequent breakdowns at wells during the periods of which all wages are automatically cut in half and there is, naturally, no legal or any other check against labor's anxiety to find some other employment in order to augment its meager wage.

From official reports on labor and labor conditions at Baku, Grozni and other major Soviet oil fields the impression is obtained that very few of such drilling teams, which as a rule settle on the oil fields for good have actually remained in the fields. The so called "old timers" have migrated or have dispersed for economical, political or other reasons and the drilling divisions have to depend largely upon labor casually shifted from other trades. Although some of these newcomers have attained high skill the situation is particularly grave in the new oil regions which were discovered during recent years such as Lokbatan, Kala and others adjacent to Baku but situated outside of the city settlements. Early in 1933 when these oil fields became known and famous for their record gushers the influx of labor assumed unprecedented proportions owing to premiums or irregularly high wage rates. At present when all gushers have become past history wage rates have been coordinated with regular schedules and the mere additions of ten percent to regular wage for their "out of the way position" serves little to attract labor. Inadequate supplies of food and consumers goods or poor housing facilities form additional factors to cause labor in these fields to be unreliable and transient.

Regional Communist Party and government authorities have made every attempt to settle the personnel and labor forces to places of employment including such measures as irrevocable refusals of leave or discharge, but it is not

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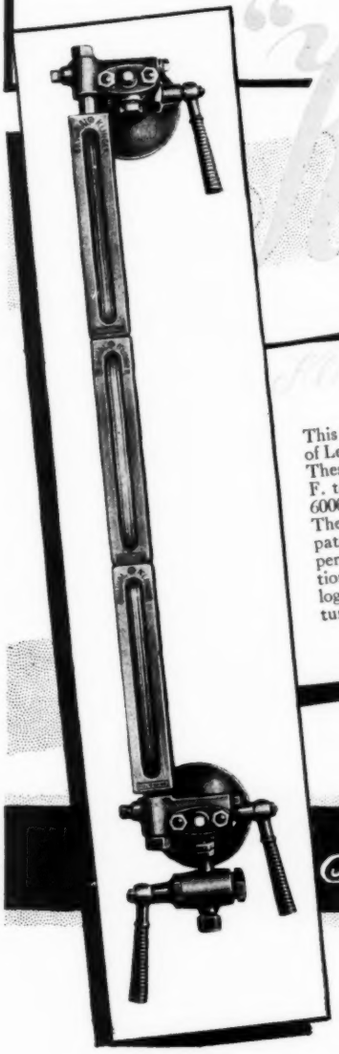

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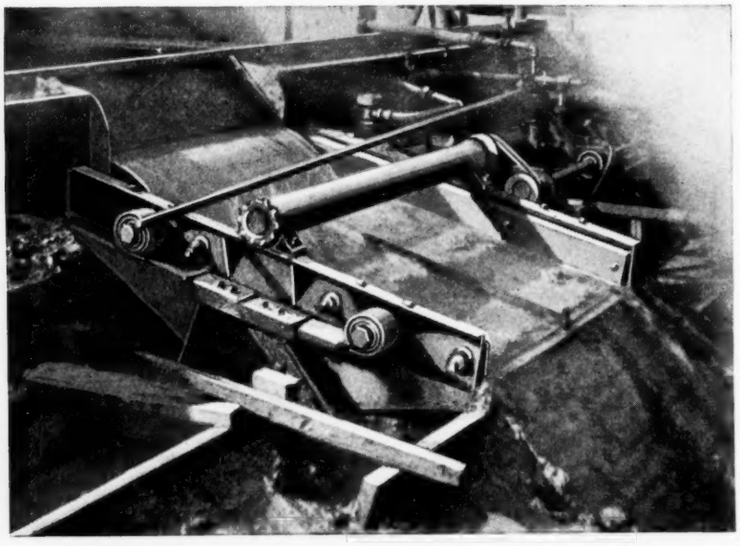

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an easy matter to compel migrating labor to settle. This class of labor will invariably find a way out. It will commit a minor misdemeanor and will get a discharge. Coming late to work is the most practised misdemeanor; but coming to work on time is practically impossible owing to disorganized transport. Trains are congested and seldom run on schedule. On pay day after work long lines of all sorts of labor leave the oil fields for other locations on foot. Even among labor with a greater inclination to settle there is a strong trend toward city centers where housing facilities are more assured and comfortable.

Labor conditions at Grozni are somewhat different. Breakdowns at wells in Grozni oil fields are carried to court for adjustment and the driller usually receives the blame. The courts have thus become the institution for the appraisal of drilling qualifications and in accordance with such appraisal corresponding punishment is administered. The field management prefers to let the courts correct the habits of the drillers although it well understands the futility of such methods.

About 400 drillers are at the disposal of Grozni and more than half of this number have had less than twelve months of oil well drilling experience. About 25 percent of all drillers of Grozni have had drilling experience of more than one year and exactly 27 drillers have been in the drilling trade more than three years. Their previous experience was mainly mule driving, common labor, etc., but at any rate most of the drillers at Grozni are practically illiterates, while only four percent have had some sort of preliminary school education. The bulk of drillers at Grozni are hardly qualified for the job. Of course there are special schools for drillers, but all graduates from such schools are considered unfit for responsible

Soviet Internal Consumption Petroleum Products

	1934 (tons)	1933 (tons)
Gasoline	1,501,000	1,095,000
Kerosene	3,547,000	3,230,000
Lubeoil	1,126,000	1,019,000
Fuel and Gasoil	9,003,000	8,264,000
Asphalt	172,000	97,000
Paraffin Wax	15,000	9,000
All other	142,000	120,000
Total	15,506,000	13,834,000

Internal Consumption

	Jan.-April 1935 (tons)	Jan.-April 1934 (tons)
Gasoline	433,633	346,812
Kerosene	1,060,533	929,078
Lubeoil	227,346	252,913
Fuel and Gasoil	2,417,050	2,472,274
All other	122,395	110,609
Total	4,260,900	4,111,686

Value of U. S. S. R. Trade

	1st quarter 1935	1st quarter 1934	Total 1934	Total 1933
	(Roubles=000 omitted)			
Total exports	67,294	84,595	418,345	495,658
Total imports	49,043	49,484	232,426	348,216
Oil exports	10,270	15,137	59,611	75,671
Timber	2,658	4,758	89,788	76,730
Grain	1,871	7,407	19,086	46,524
Furs	5,978	8,981	32,276	38,557

jobs and actually seldom used as drillers in the fields.

The recent class of drillers which has graduated 26 members has had a long struggle to find any job in the oil fields and were finally accepted as common labor.

Between June 20 and 24 a conference of the Soviet oil industry on refining and refinery building was held at Baku under S. Ordzonikidze, Commissar for Heavy Industries, assisted by Rukhimovitch, Vice Commissar for Heavy Industries and M. Barinoff, head of Glavneft. The following representatives of the oil industry and of domestic machine shops engaged in building oil equipment were present and actively participated in the discussions:

S. B. Slutzki, Azneft Refinery Trust, Baku.
L. Nuremberg, Grozni, Refining Trust.
Prosumentik, Stalin Refineries, Baku.
Markaryan, Cracking Plants, Baku.
Bogoslovski, Cracking Plants, Saratoff.
Krassilnikoff, Cracking Plants, Gorki.
Dubrovaya & Akopov, Neftgas Plant, Moscow.
Krisin, Neftproject, Moscow.
Ackerman, Ufa Refinery.
Rilin, Neftstroi.
Ivanov-Kavkazki, Glavmarlit.
Drushinin, Marti Machine Works, Baku.
Bytchkov, Koshkin Works, Moscow.
Akopoff, Podolski Machine Works.
Nikulin, Glavgormash.
Nemoff, Voti Machine Works.

Mr. Feinberg of Glavgormash reported that the following domestic machine shops are at present engaged in design and building of oil equipment: The Podolski Works, The Red Hammer Plant of Grozni, Kiroff Works of Gorlovka, Stalin Machine Plant at Baku, "Miners Light Plant," "Baku Worker" of Baku, the Compressor Works and the Novoye Sormovo which is specializing in heat exchangers. These domestic plants are at present engaged in design and building of eight two-furnace cracking units, two installations for secondary rerun, one atmospheric pipe still and continuous treating of cracking gasoline and one pipe still for processing sulphur-containing crude at Ishimbayevo. In addition extensive operations have been ordered for the reconstruction and enlargement of all existing refineries. The immediate plans for 1935 call for the completion of six pipe still units and 14 cracking installations, besides the design of 32 more cracking units which will be erected after 1935.

S. Slutzki, who has recently received the Lenin order for successful operation of Baku refineries, pointed out that Baku refineries are in good shape, but they are operating behind United States standards. The gasoline yield amounts to about 25 percent of the crude potential while the corresponding figure for U. S. refineries is over 45 percent. The newer units yield about 35–37 percent of gasoline. The Grozni refineries are of more modern type and yield about 10 percent more gasoline than the refineries of Baku, but the losses are much higher.

Mr. Rukhimovitch at the conference emphasized the strained situation in regard to gasoline and ligroin and demanded more cracking. This, however, depends largely upon the ability of the domestic machine shops to cope with the demands in design and building of at least 14 cracking units to be erected in 1935 and 1936. He also demanded more and better research and advocated an extensive exchange of experience between the interested organizations in order to avoid duplication of efforts.

M. Barinoff accused the Glavgormash organization that all domestic building is very expensive and takes more time and is of low quality in addition. This, M. Barinoff thinks, is responsible for the high arrears of the oil industry against plan.

S. Ordzonikidze made a long speech in which he has characterized the present situation of the oil industry in general, and pointed out in particular the causes for arrears in crude production and run to stills and has outlined concrete steps to alleviate the stringency.

J. WEGRIN

▼

Distillation Unit for Abadan

AS PART of the extensive improvement of its refinery at Abadan, Iran, the Anglo-Iranian Oil Company has placed a contract with E. B. Badger & Sons Company of Boston, U. S. A. for a crude distillation unit of 80,000 bbl. total daily capacity with a normal input of 65,000 bbl.

U.S.S.R. Refinery Yield of Major Products

(1,000 tons)

	1934			1933	
	Plan	Actual	Percent Plan	Actual	Percent Change
Straight run gasoline	1,701	1,468	85.3	1,488	0.0
Cracking gasoline	817	832	101.2	681	+22.0
Ligroin	482	506	105.0	486	+ 3.5
Total	3,000	2,806	94.5	2,455	+ 5.0
Kerosene	4,964	4,467	90.4	3,678	+15.7
Lubeoil	1,302	1,555	119.0	1,297	+19.0
Asphalt	316	255	80.0	–	–
Paraffin wax	32	31	97.0	18	+70.0
Coke	15	204	136.0	–	–

Baku Refinery Operations

(1,000 tons)

Crude Grades Run to Stills	Plan 1934	Actual 1934	Percent Ratio to total	1933	Percent of total
Light crude	9,581	8,628	64.2	8,880	71.7
Heavy crude	3,419	4,777	35.6	3,463	28.0
All other	–	27	0.2	46	0.3
Total	13,498	13,430	100.0	12,389	100.0

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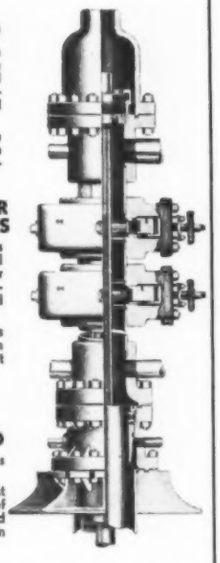

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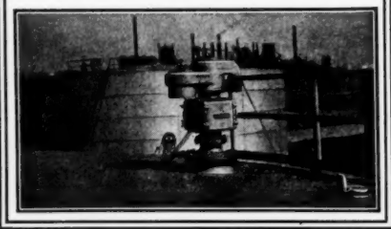

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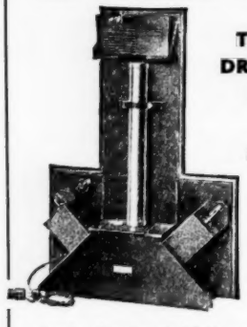
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Walter D. Cline

▼

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Consolidated Moves

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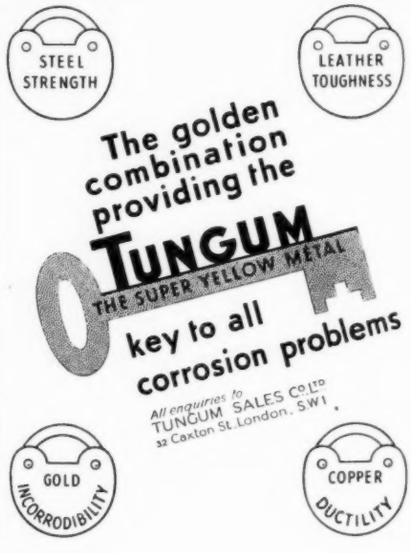
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